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CANADIAN PACIFIC RAILWAY

SANDFORD FLEMING, C.M.G.

ENGINEER-IN-CHIEF.

REPORTS AND DOCUMENTS

IN REFERENCE TO

THE LOCATION OF THE LINE

AND A

WESTERN TERMINAL HARBOUR.

1878.



OTTAWA:

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CANADIAN PACIFIC RAILWAY

REPORT

BY

SANDFORD FLEMING, C.M.G.,

ENGINEER-IN-CHIEF

ADDRESSED TO

THE HONOURABLE THE MINISTER OF PUBLIC WORKS,
CANADA

CANADIAN PACIFIC RAILWAY

OFFICE OF THE ENGINEER IN CHIEF,

OTTAWA, April 26th, 1878.

The Honourable A. MACKENZIE,
Minister of Public Works,

&c., &c., &c.

SIR,—I have the honour to report on the operations which have been carried on to determine the location of the Canadian Pacific Railway, and to establish the locality on the Pacific Coast best adapted for its terminal point.

In my last General Report, February 8th, 1877, I endeavoured to furnish a concise record of these operations from the commencement of the survey in 1871; I further submitted what other important information had been acquired from various sources. In the following pages I shall have occasionally to refer to that General Report.

During the past season the investigations have been confined to the following surveys and explorations:—

1. A trial location of the line (No. 2), extending from Yellowhead Pass, *via* the Rivers Thompson and Fraser, to Burrard Inlet.
2. An exploration from Port Simpson, on the Pacific Coast, by the valley of the River Skeena, to the Central Plateau, and thence to Fort George.
3. An exploration from Fort George, through the Rocky Mountain Chain, by Pine River Pass.
4. A nautical examination, by the Admiralty, of the mouth of the River Skeena.
5. Surveys, between Selkirk and the south branch of the Saskatchewan, for an alternative line.
6. Surveys between Lake Nipissing and Lake Superior.
7. Explorations to Lac la Biche and other points lying to the north of the main Saskatchewan.

A Report, dated 4th January, 1878,* on these operations and on the progress of the works under construction, has been made by my Chief Assistant, Mr. Marcus Smith. A Report dated the 23rd inst.** has also been furnished by Mr. H. J. Cambie, Engineer in charge of Surveys in British Columbia, on the results established by the location survey of the line from Yellowhead Pass to Burrard Inlet. These reports, together with a memorandum† on explorations from Port Simpson by the River Skeena to Fort George on the Fraser, are appended.

Supplementary Reports have been likewise made by Mr. Smith and by Mr. Cambie: the former submitting the advantages which appear to him to be presented by a line which, diverging from the located line at Northcote, near Lake Winnipegosis, is projected to run through the Pine River Pass to Bute Inlet: the latter furnishing additional information with regard to the line by the Rivers Thompson and Fraser to Burrard Inlet; and showing the comparative advantages claimed in regard of that route. Both Reports, together with a Report on the exploration made of the Pine River Pass, are appended.*‡

* Appendix A. page 17. ** Appendix B. page 30. † Appendix C. page 38. ‡ Appendices D., E. and G. pages 41, 55 and 72

Some correspondence has taken place on the subject of the Terminal Harbour in connection with the examination made last summer, under instructions of the Admiralty, by Imperial Naval Officers, of the mouth of the River Skeena. This correspondence is appended.*

In reporting on this important subject, the general question presents itself to my mind under two aspects; first, in respect to the influence which the Railway will exercise on colonization; second, as a through line of steam communication between the Atlantic and Pacific Oceans.

1. The early settlement of the Eastern Provinces of Canada followed the coast of the Sea-board, and the margin of the land traversed by the Great Rivers and Lakes. The natural water-ways accordingly were important auxiliaries in directing successive waves of Emigration to points of settlement; and, doubtless, the water communications of the interior of the Dominion, west of Lake Superior, will prove valuable accessories in this respect. They may be largely utilized during the early stages of colonization; and when settlements have been effected, and the various districts become inhabited, the more important will still be valuable as the means of transporting heavy products.

Climatic conditions, however, impose a limit to their use. During four or five months of the year the rivers and lakes are frozen, and navigation is closed; and thus the absolute necessity of a system of Railways is imposed before any extended and permanently prosperous settlement can be attained. More especially is this the case where the water lines are broken or disconnected, and the localities are far removed from open navigation.

In examining into the question of colonizing the vast undeveloped interior of Canada, we are called upon to consider what main lines of communication may, in after years, be regarded as essential. It is desirable to take a comprehensive view of the subject, as we may be regarded as preparing the way for the occupancy of Territory capable of sustaining millions, and as dealing, to no limited extent, with the destinies of half a Continent.

* Appendix F. page 62.

I have elsewhere given my views as to the principles which should govern the establishment of Railways in such circumstances.* In the case of the territory under consideration, from information we have gathered, we are justified in assuming that, ultimately, not one Railway, but many Railways, will hereafter be needed. At one time it was thought that the habitable land was confined to a comparatively narrow fertile belt along the immediate valley of the Saskatchewan; now, it is considered that the belt is of immense breadth, and that the habitable territory is of vast extent. It is therefore to be anticipated that one Railway will eventually prove insufficient for the traffic of the country, and that two trunk lines, with numerous branches, may hereafter be required.

We have but to place before us a map of the United States and Canada, to note the lines which run from the seaboard westward, in some sections ramifying in many directions: lines on which the traffic is regular and constant, and which, thirty years ago, not the most sanguine of projectors would have ventured to foretell as indispensable.

In the paper referred to, I have set forth the importance of strictly observing certain principles in the establishment of Railways in a new country, in order to avoid hasty and ill-considered construction; to prevent mis-application and waste of capital by assuring that no unnecessary line be undertaken, that no lines be completed, before they are wanted, and that the highways of the country, of every class, be designed so as to perform their functions in the most satisfactory manner.

2. By the establishment of Railways, on the principles which I have described, steam communication from the valley of the St. Lawrence to British Columbia would be a matter of no speedy attainment. A through line being, however, required for other than colonization reasons, it becomes necessary to consider how that connection can with least difficulty be effected.

The map which I submit with this Report, shows lines of Railway, which, possibly, may in time be required for general service, all of which should be kept prominently in view. The engagements of the Government are to secure without delay one through line, and if it be probable that these lines will all ultimately be required, it is evident that that which is the most easy of construction is the one which, under the present circumstances, should be selected.

* Appendix H, page 83.

In my Report of February 8th, 1877, I described all the routes projected at that date. I submitted approximate estimates of cost as well as naval testimony with respect to the harbours on the coast, and I attempted to narrow down the enquiry by rejecting all projected lines and proposed termini, except the most satisfactory and important.

I pointed out that there is no harbour on the mainland entirely unobjectionable; that on the outer coast of Vancouver Island, there is more than one harbour well suited for the purpose of a terminus; that it was exceedingly desirable to carry the railway to at least one of these harbours; but that they all could be approached from the interior only at an enormous cost.

By this process of elimination I reduced the number of available routes to three, viz:—

Route No. 2, terminating at Burrard Inlet.

Route No. 6, touching tide water of the Pacific first at Bute Inlet.

Route No. 11, terminating near the mouth of the River Skeena.

The examinations made during the past season have not materially changed the circumstances under which these separate lines were considered: and the trial location survey to Burrard Inlet, substantially confirms the general accuracy of the estimates of cost.

The exploration to Pine River Pass is of value in confirming the impression referred to in my report of last year that a low lying available passage exists across the mountains in that latitude; but there is nothing to show that so good a route can be obtained in that locality as by the Peace River Pass. As already stated, it has been suggested to carry the line from the east through Pine River Pass to Bute Inlet. Mr. Smith has given prominence to this line in his Report 29th of March last as a means of reaching the coast. I do not attach the same importance to the Pine River Pass. It is certainly lower than the Yellow Head Pass; but its position is not favourable for reaching a southern terminus. Moreover, although favourably situated for a line to a northern terminus, its importance is not enhanced by the fact that a still

lower pass—Peace River—exists, only a few miles further north. I have accordingly projected a northern line of Railway through Peace River Pass, which I consider preferable.

The correspondence respecting the examinations at the mouth of the Skeena River by the Admiralty proves the non-existence of a suitable harbour immediately at that point; but our own explorations show that an excellent harbour exists at Port Simpson, in the neighbourhood of the Skeena, and that there are no great obstacles to be met in carrying the railway to it.*

I find also that Commander Pender has a favourable opinion of Port Simpson. At page 295 of my last General Report (February, 1877), he states: "Port Simpson, at the north part of Tsimpsean Peninsula, is the finest harbour north of Beaver Harbour, in Vancouver Island."

It will be seen from the correspondence with the Admiralty that a northern terminus is objected to on account of climatic features incidental to a high latitude. But no data have been furnished to show that the climate is materially different from that on the coast of Great Britain, in similar latitudes such as the North Channel, and the approaches to the River Clyde; and it cannot be overlooked that although the climate on the west coast of Scotland may be considered far from good, Glasgow, one of the most enterprising and important cities in the world, has come into existence in the latitude referred to.

Commander-in-Chief, Admiral DeHorsey, on the Pacific Station, objects to Burrard Inlet (*vide* despatch to the Admiralty, 26th October, 1877,) and advocates carrying the Railway to a harbour on Vancouver Island, in the manner set forth in my Report of February 8th, 1877, page 72. The Admiral, equally with most of the other naval authorities, objects to Waddington Harbour as a terminus.*

The deductions to be drawn from the naval testimony at our command, and from our own examinations, may be thus summarized:—

1. That there can be no question as to the superiority of certain harbours on the outer coast of Vancouver Island.

Appendix A, page 23, and Appendix C, page 38.

2. That Waddington Harbour is not favourably situated for a terminus, and may be viewed as a preliminary and temporary station only, the true terminus of a line by Bute Inlet being Esquimalt, or some other harbour on the outer coast of Vancouver Island.

3. That a terminus at Port Simpson would have the advantage of possibly the best harbour on the mainland; and that of all the terminal points projected on the mainland and on Vancouver Island, Port Simpson is most conveniently situated for Asiatic trade. But Port Simpson is open to climatic objections, which are not experienced to the same extent at points farther south.

4. That of all the other points on the mainland, Burrard Inlet, an arm of the Strait of Georgia, is the least difficult of approach from the ocean, and is generally preferred by the naval authorities.

5. That Burrard Inlet, equally with Waddington Harbour, is open to the geographical objections mentioned in my last General Report (page 71).*

With these deductions, the comparison may be said to be confined to the three lines terminating respectively at Port Simpson, Esquimalt and Burrard Inlet.

The route terminating at Port Simpson has not been surveyed. On reference to the map, it will be seen that it is projected to follow the River Skeena, and thence, eastwards to Peace River; thence by Lesser Slave Lake, and Lac la Biche, keeping about 140 miles to the north of the line located by the Valley of the Saskatchewan. Being unsurveyed, and but little being definitely known concerning it, it is not possible to compare it with the other two lines, which have been located throughout the greater part of their length. If, therefore, this northern line is to be seriously considered, it is indispensable that a thorough survey be made of it. With our present knowledge, it will be unwise to adopt it as the route for the Railway, and to determine on proceeding with construction, without obtaining full and complete information regarding it. My own opinion is in favour of gaining information, and if the Govern-

*The Strait of Georgia is separated from the ocean by two archipelagoes, one to the north, the other to the south of Vancouver Island.

The approach by the north of Vancouver Island to the Strait of Georgia is hazardous and objectionable.

The approach by the south of Vancouver Island, is through passages more or less intricate, between, or at no great distance from, islands known as the San Juan group.

The most important islands of the San Juan group are in the territory of a foreign power, and from their position they hold the power of assuming a threatening attitude towards passing commerce.

ment entertain this view, I beg leave to suggest that during the present year a continuous exploration be made from Port Simpson eastwards to a point of junction with the located line in the neighbourhood of Lake Winnipegosis.

If, however, the Government deem it essential to arrive at an immediate decision, the northern route, being insufficiently known, cannot be entertained, and thus two lines only remain for consideration, one terminating at Esquimalt, the other at Burrard Inlet.

The respective engineering merits of the two lines are sufficiently described in my last General Report and in the Reports of Messrs. Smith and Cambie, appended.

It only remains for me to submit some additional general remarks.

Manitoba is as nearly as possible about midway across the continent. From the crossing of Lake Manitoba to Burrard Inlet, the distance is more than 1,100 miles; and to Esquimalt more than 1,400 miles. In the whole of the territory throughout these distances, there are few civilized inhabitants, probably not more than 12,000. I do not speak of the Indian population; they can hardly be considered as influencing, to any considerable extent, the project of the Railway.

It is thus evident that, whatever may be needed hereafter for connecting prosperous and populous communities, there is not, at this moment, any pressing necessity for the Railway, for ordinary purposes. For special reasons, however, the construction of the Railway to the Pacific Coast is demanded, and, in the absence of traffic to sustain it, it becomes more than ordinarily important to adopt that route which will least involve the sinking of unproductive capital, and by which the loss to be borne in working and maintenance will be least heavy.

I have expressed my conviction that, ultimately, the country will require a comprehensive Railway system; and that, besides branches in many directions, probably two leading trunk lines will eventually be demanded. These requirements, however, only lie in the future, and, possibly, may be somewhat remote. But it is of vital importance to burden the future as little as possible with accumulated losses resulting from operating the line. The selection of a line the least expensive to construct and to maintain is an essential point to be kept in prominence. It is even still more important to adopt the route which will not create the largest debt, through

rapidly accumulating losses, resulting from the expense of working being in excess of receipts.

I have submitted that, if the line by Peace River to Port Simpson be thrown out for the present, there remain to be considered the two lines terminating at Burrard Inlet and Esquimalt. •

Burrard Inlet is not so eligible a terminal point as Esquimalt. It cannot be approached from the ocean, except by a navigation more or less intricate. Nor can it be reached by large sea-going ships without passing at no great distance from a group of islands in the possession of a foreign power, which may at any time assume a hostile attitude and interfere with the passage of vessels.

To the first objection it may be said that there are other harbours in the world, with an enormous extent of commerce, with entrances where shipping is not entirely free from delays and risks. New York, Liverpool, Glasgow and Montreal may be instanced. The second objection would appear to a non-combatant like myself a forcible one; but those who are held responsible for maintaining communication by land and sea in times of war appear to make light of it. It is impossible, however, to deny that, other things being equal, Esquimalt as a harbour and terminal point is superior to Burrard Inlet.

Regarding the question simply from a commercial standpoint, let us assume, for the sake of the argument, that a Railway is completed and in operation to both points, and a person at Esquimalt desires to travel to Ottawa. He has the option of crossing by steamer, 90 miles, to Burrard Inlet and then using the Railway; or of taking the train at Esquimalt, and proceeding on his journey from that point. In the latter case, taking the most favourable view, he would have to travel some 150 miles farther, or if the line were carried through by Pine River Pass, fully 200 miles farther, than by way of Burrard Inlet.

It is evident that, even were the wide channels at the Valdes Islands bridged the Railway carried to Esquimalt would present no advantage in time or cost to an ordinary traveller. If passengers from Esquimalt could secure no benefit from the extension of the Railway to that place, it is certain that a loss would be sustained in carrying freight by the longer route.

The cost of extending the Railway to Esquimalt would greatly exceed that of

taking it to Burrard Inlet ; there are no sufficient data for forming a proper estimate of the cost. But even by leaving a gap near the Valdes Islands of 15 miles, and substituting a ferry for the enormously costly bridging at that locality, the excess would probably reach \$15,000,000 or \$20,000,000. The cost of maintenance would be great in proportion, and the annual losses on working the extra mileage would, under the peculiar circumstances, be serious.

It is difficult to recognize any commercial advantage in carrying the line to Esquimalt, at this period in the history of Canada, to compensate for these grave objections. I have assumed Esquimalt as the Vancouver Island Terminus. If the other Harbours, Alberni or Quatsino, were substituted, the argument remains unchanged, the conclusions differing only in degree. If we abandon the idea of extending the Railway to Vancouver Island, and fall back on Waddington Harbour, we should have for a Terminus a point not favoured by the principal naval authorities, and partaking of the geographical objections to Burrard Inlet, while some of the advantages possessed by the latter place would be wanting.

Upon carefully viewing the engineering features of each route, and weighing every commercial consideration, I am forced to the conclusion that, if these alone are to govern a selection, if a decision cannot be postponed until further examinations be made, if the construction of the Railway must be at once proceeded with, the line to Vancouver Island should, for the present, be rejected, and that the Government should select the route by the Rivers Thompson and Fraser to Burrard Inlet.

I have great faith in the future of a country favoured with a bountiful supply of the natural elements of prosperity. The capabilities of the territory of the Dominion on the Pacific Coast, are great. Vancouver Island alone is capable of supporting, by the industries which may be established, a large population ; but this result may not be attained for many years. When the Island becomes fully inhabited, an independent Railway system, which by that time may be created within its limits, may then, with comparative financial ease, be connected with the main land, by way of Bute Inlet, as necessity may dictate.

If the mining industries of Cariboo become permanently profitable, a branch to that district could be constructed from some point between Lytton and Tête Jaune Cache. This branch would shorten the link to be filled up between the separate

railway systems to be created on Vancouver Island and on the mainland, and render the connection less difficult of attainment hereafter.

In former reports, I have directed special attention to the paramount importance of securing a line through the country with easy gradients.* In the case of Branch Railways, such as those projected on the accompanying plan, there is not the same necessity for light gradients. These branches will be local lines, with limited traffic. Their functions will simply be to serve productive districts to the right and left, and to collect traffic for the main thoroughfare. The branches may therefore be of a cheaper and less perfect character; but in order to secure the means of the cheapest possible transportation over long distances, the trunk line should have the lightest gradients obtainable.

The line located from Lake Superior to Burrard Inlet commands generally more than ordinarily favourable gradients. If the railway be constructed on this route in the manner which I have recommended, cheapness of transportation will be assured, and advantages will accrue in the future of the most important kind.

It is my sad duty to add to the record of lives lost, the names of those members of the Engineering Staff who have passed away during the past year.**

I have the honour to be, Sir,

Your obedient servant,

SANDFORD FLEMING,

Engineer-in-Chief

NOTE — *Vide* Report of 1874, page 32, and Report of 1877, pages 81 and 85.

** Appendix K, page 104.

APPENDIX A.

REPORT ON SURVEYING OPERATIONS AND CONSTRUCTION FOR THE YEAR 1877, BY
MR. MARCUS SMITH, ACTING ENGINEER-IN-CHIEF.

CANADIAN PACIFIC RAILWAY,
OFFICE OF THE ENGINEER-IN-CHIEF,
OTTAWA, 4th January, 1878.

SIR,—I have the honor to report on the progress made in surveying operations and construction to the 31st December, 1877.

SURVEYS IN THE EASTERN OR WOODLAND REGION.

In the season of 1876, a trial location survey was made from the proposed Eastern terminus, near Lac Amable du Fond, about 23 miles south-east of Lake Nipissing, to Cantin's Bay on French River, and, from this line, explorations were made of the country extending north-westward, on a course as direct as practicable, to a point on the north shore of Lake Superior, near the mouth of the River Pic.

These explorations were not completed; and portions of the trial location above referred to were not satisfactory, as the low gradients that had been expected were not obtained.

During the past season, four surveying parties were employed in completing these exploratory surveys, and improving the location of the line of the previous year. The plans and profiles are in progress, and the following is an outline of the results of the season's work.

Location of the line from South River to Cantin's Bay on French River.

This line commences at a point on South River about 3 miles from its mouth on Lake Nipissing, and 22 miles north-west of Lac Amable du Fond, where the survey of the previous year commenced. It follows down the left bank of the river to the shore of Lake Nipissing; thence it takes a course nearly west to the 20th mile, from which its course is south-west to the 35th mile, where it joins the survey of the previous year, and then follows that line on a course nearly west to the head of Cantin's Bay, $49\frac{1}{4}$ miles from the point of beginning. If extended to the foot of the bay its length will be $55\frac{1}{2}$ miles.

This bay—a sheet of water about 5 miles in length, and averaging nearly a quarter of a mile in breadth—lies at the confluence of the Pickereel and south branch of French River, about 20 miles from the mouth of the latter on the Georgian Bay. Its altitude varies from 4 to 6 feet higher than that of the latter; ~~so~~ that to extend the navigation of the Georgian Bay to Cantin's Bay, a lock would be required to surmount the rapids near the mouth of the river, the rest of the distance being still water; it is, in fact, a long narrow lake.

The country traversed is generally rocky, and broken up with numerous lakes and small streams running in narrow valleys or ravines.

The altitude at the starting point on South River is estimated 678 feet above sea level, being 530 feet lower than that of Lac Amable du Fond, and the highest point on the line is 813 feet, being 407 feet lower than the summit altitude of the line of the previous year. But still the proposed maximum gradient of 1 in 200, or 26.40 feet per mile, has not been obtained. The gradients can, however, be kept down to a maximum of 1 in 150, or 35.20 feet per mile, rising eastward, without involving very heavy works. Of this gradient of 1 in 150, there are ten separate lengths, making a total of about 8 miles. In descending to Cantin's Bay, however, the gradient

is 1 in 133, or 39.60 feet per mile; but it is expected that this can be reduced by a slight deviation, and lengthening of the line. Of the maximum of 1 in 100, rising westward, there are seven short lengths, making an aggregate of $5\frac{1}{4}$ miles.

The works will be generally lighter than on the corresponding length of the line surveyed in 1876. The heaviest will be in rock cutting, running from 5 to 25 feet of maximum depth, and 300 to 800 feet in length, with embankments of somewhat larger dimensions. There will be about 12 miles on which work of this character will occur, and 14 miles on which there will be rock cuttings varying from 6 to 15 feet of maximum depth, and averaging about 500 feet in length. The balance will be moderately light work.

The principal bridging will be as follows:—

Beatty's Creek.—Ravine 250 feet wide, with a maximum depth of 40 feet.

Commanda Creek.—Breadth of valley 620 feet, maximum depth 62 feet, breadth of stream 120 feet.

Outlet of Lake Mahmasagamising.—One span of 100 feet.

Pickrel River.—One span of 150 feet.

Pickrel River Branch.—Breadth of ravine 220 feet, maximum depth 35 feet, breadth of stream 40 feet.

In addition to these, there will probably be some bridging required in ravines where material for embankments cannot be obtained in the vicinity.

Surveys and Explorations from French River to Lake Superior.

Exploratory surveys have been made of two lines extending westward from different points on the line last described, and meeting at a common point in the valley of the Wahnapitewee.

The northern, and most direct, line diverges at the 19th mile of the located line, and takes a general course a little to the north of west. Continuing the mileage from South River (Lake Nipissing) it crosses the main branch of French River near the 26th mile, at the Chaudiere Falls, where the trough of the River is contracted to 200 feet, and the breadth of the stream to 50 feet. Near the 29th mile, it strikes the north branch of this river, and follows down its left bank to the 34th mile, where the line crosses the river, which at this point is 200 feet wide, and 10 feet deep.

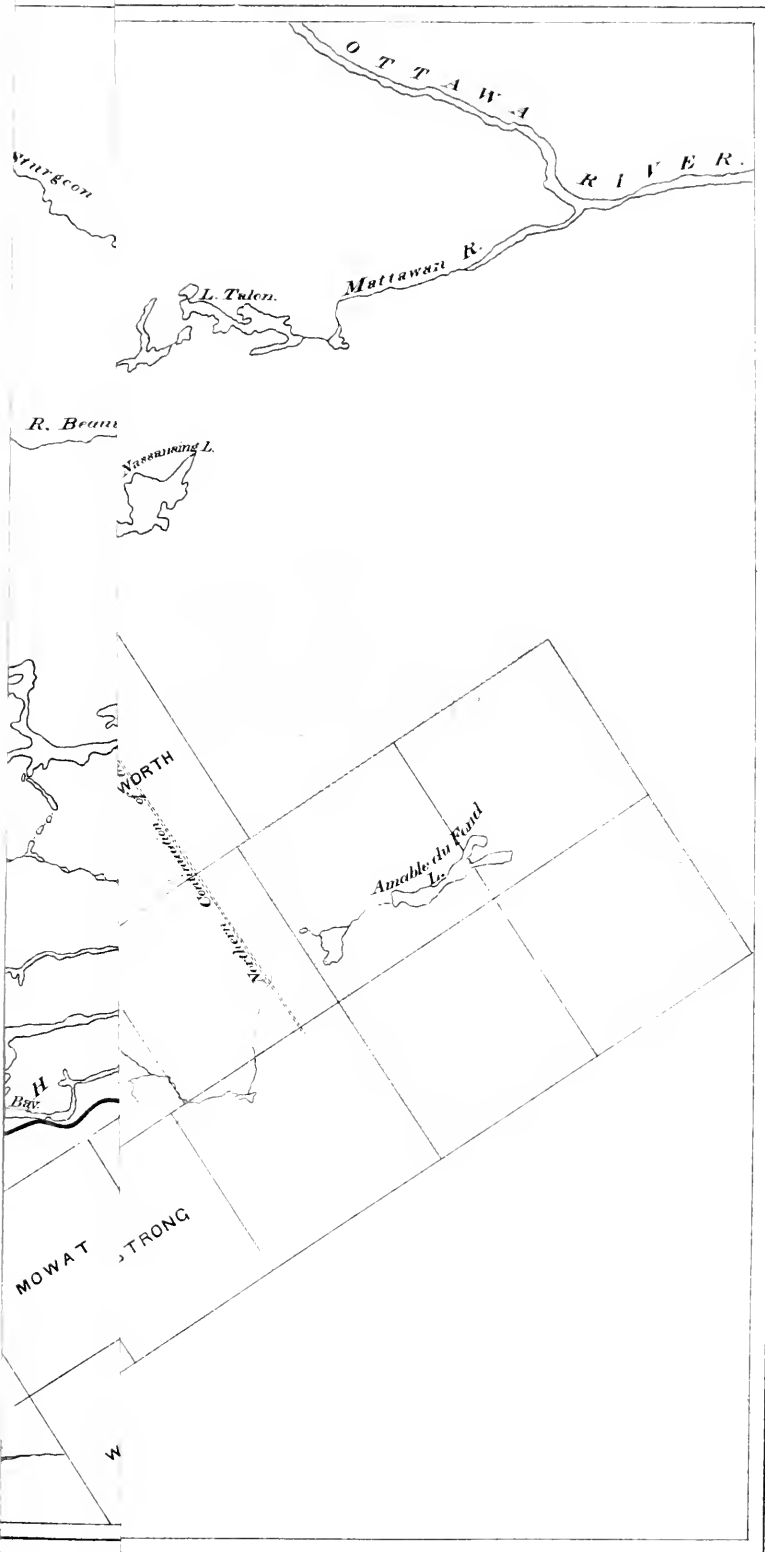
At the 39th mile, it crosses another arm of French River, 200 feet wide; thence it follows a chain of narrow valleys which are separated by low rocky ridges. Near the 61st mile, it crosses Lake Maskinonge, 1,700 feet wide and 18 feet deep, which can, however, be reduced by drainage. The line reaches the Wahnapitewee Valley at the 72nd mile.

There is very little variation in the altitude of the country throughout this section, and the gradients are generally easy. The works would be variable, as the line alternately runs in the valleys or across intervening ridges. There will be an aggregate of about 11 miles on which rock cuttings, varying from 5 to 15 feet of maximum depth, but in short lengths, would occur. On the rest of the line the works would be medium or moderate.

The southern line leaves the located line at the 48th mile near the head of Cantin's Bay, and within half a mile it crosses the Pickrel River, which is here 250 feet wide and 5 feet deep. It then follows the north shore of Cantin's Bay, and crosses the main Branch of French River at the Horse Rapids, where the channel is 200 feet wide. Near the 55th mile, it crosses another branch of this river, 40 feet wide, and at the 57th mile it crosses the north branch, where the channel is 250 feet wide.

Thence, the line takes a generally north-westward course, following a chain of narrow valleys and lakes. It crosses the south end of Lac de l'Isle at the 74th mile, and following another chain of valleys and flats, separated by rocky ridges, it joins the line last described near the 81st mile.

This is $9\frac{1}{4}$ miles longer than the northern line, but the whole of it would be part of the main line, while the northern would have a branch of 30 miles to Cantin's Bay, making $20\frac{1}{4}$ miles more line to be constructed. The gradients on this line are very



easy, and the works would be very similar to those on the northern line first described.

On both lines there are detached tracts of land fit for cultivation, with spruce, tamarac, cedar, birch and poplar, which would furnish railway ties. There is a small quantity of hemlock and pine, but most of the latter has been burnt off by bush fires. On Cautin's Bay and near the Chaudiere Rapids, there are large patches of sugar maple.

Explorations with Barometer and Compass.

The altitudes and distances from this forward must be taken as approximate. The distances hereafter referred to are estimated from the starting point on South River by the northern or direct route.

The River Wahnapitepee is 200 feet wide where the line crosses it, and the altitude is 632 feet above sea level. Thence the line of survey takes a general north-west course, ascending diagonally the slope or water shed of Lake Huron over a rough and rocky country, intersected with numerous, narrow, trough-like valleys, and indented with lakes and swamps, rocky ridges intervening. Still, a feasible line has been found without very high gradients or exceptionally heavy work up to the Vermillion River, at the 106th mile. At the 85th mile it crosses the long valley running in a south-west direction, in which lies the chain of narrow lakes known as Long Lake. The altitude at this point is 810 feet. The rocks up to the 97th mile are generally gneissoid, but westward of this, slate is the characteristic of the country. The highest point on this section is at the 97th mile, where the altitude is 1010 feet: at the crossing of Vermillion River—106th mile—near the foot of Vermillion Lake, it is 936 feet.

The line follows the north shore of Vermillion Lake 4 miles, then crosses a hilly and rocky tract to Spanish River, which is reached at the 135th mile, altitude 1070 feet. Between this and the River Aux Sables, the country is very rough, and the course of the line tortuous.

The ascent is by terraces, and in some places is very abrupt, more especially from the 147th mile to Rocky River at the 160th mile, where the altitude is 1411 feet. There will be some high gradients, and a large proportion of heavy works throughout the section from Vermillion River to the River Aux Sables. At the 175th mile, the line crosses this river near the foot of Lake Aux Sables, altitude 1512 feet. This is near the watershed between Lake Huron and Hudson's Bay. Thence its course is more uniform, and there is very little variation in the altitude for the next 100 miles, so that the gradients are very easy, and the works will be generally light or medium.

The line strikes the River Epinette at the 204th mile, about a mile above its confluence with the Mississagua. Thence it follows up this stream, and its affluent the Cypress, to the source of the latter in Lake Wagong at the 220th mile, where the altitude is 1440 feet. It crosses the River D'Embarras at the 222nd mile, and passes the south end of Lake Winnibegon at the 235th mile. The River Montreal, Lake Superior, is crossed at the 274th mile, altitude 1410 feet, and the Shequamkah at the 286th mile, where the altitude is 1345 feet.

On the last 12 miles the plateau is broken by numerous detached hills rising to a height of 300 or 400 feet. To avoid these, the curvature of the line would be increased, and the works would be heavier than on the rest of the plateau.

From the Shequamkah to Lake Superior a new line was explored during the last season, keeping more to the north than that of 1876, passing by the head of Dog Lake and the valley of White River, and thereby avoiding the high ground east of Sandbeach River.

The line, however, is still open to objection in many parts. The country is intersected at intervals by deep valleys and high rocky ridges, often at nearly right angles to the general course of the line, causing great variations of altitude and a large amount of curvature, with occasional high gradients, involving a considerable proportion of heavy works.

At the 306th mile, the line reaches the valley of the Michipicoten near the foot of Whitefish Lake, an expansion of the river, altitude 900 feet,

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easy, and the works would be very similar to those on the northern line first described.

On both lines there are detached tracts of land fit for cultivation, with spruce, tamarac, cedar, birch and poplar, which would furnish railway ties. There is a small quantity of hemlock and pine, but most of the latter has been burnt off by bush fires. On Cantin's Bay and near the Chaudiere Rapids, there are large patches of sugar maple.

Explorations with Barometer and Compass.

The altitudes and distances from this forward must be taken as approximate. The distances hereafter referred to are estimated from the starting point on South River by the northern or direct route.

The River Waunapitapee is 200 feet wide where the line crosses it, and the altitude is 632 feet above sea level. Thence the line of survey takes a general north-west course, ascending diagonally the slope or water shed of Lake Huron over a rough and rocky country, intersected with numerous, narrow, trough-like valleys, and indented with lakes and swamps, rocky ridges intervening. Still, a feasible line has been found without very high gradients or exceptionally heavy work up to the Vermillion River, at the 106th mile. At the 85th mile it crosses the long valley running in a south-west direction, in which lies the chain of narrow lakes known as Long Lake. The altitude at this point is 810 feet. The rocks up to the 97th mile are generally gneissoid, but westward of this, slate is the characteristic of the country. The highest point on this section is at the 97th mile, where the altitude is 1010 feet: at the crossing of Vermillion River—106th mile—near the foot of Vermillion Lake, it is 936 feet.

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At the 306th mile, the line reaches the valley of the Michipicoten near the foot of Whitefish Lake, an expansion of the river, altitude 900 feet,

The River Magpie is crossed at the 335th mile, where the altitude is 963 feet. The highest intermediate point is 1,230 feet at the 318th mile.

From the Magpie to the head of White River at the 370th mile, the course of the line is tolerably direct, with generally easy gradients, and the works would not be heavy. The altitude at this point is 1,380 feet. Thence the line follows down the valley of White River to the 417th mile, where the altitude is 1060 feet. There is a large amount of curvature in this section, but with easy gradients, and the works would be moderately light.

From White River to the River Pie, at the 440th mile, the country is rough and full of hills, the line tortuous, with high gradients, and the works generally would be rather heavy.

The last point is on the same level as Lake Superior, 600 feet. Thence the line passes through a valley to Heron Bay, and follows the shore of Lake Superior to Peninsular Harbour, where it joins the survey of 1874, at the 452nd mile. The shore of Lake Superior from Peninsular Harbour to the River Nepigon is deeply indented with numerous bays, coves and bights surrounded by high rocky bluffs, involving a large amount of curvature on the line with occasional high gradients, and, in construction, a large quantity of rock excavation with a number of short tunnels. (*Vide* Report of 8th February, 1877, pages 206 to 210.)

The line crosses the River Nepigon near the foot of Lake Ellen, to which the length from South River is 569 miles: and if it were extended to a common point near the south-east angle of Lake Nipissing, it would be 26 miles longer than the line No. 2, explored in 1873. (*Vide* Report of 26th January, 1874, page 205.)

Following the exploratory survey of 1874 from the River Nepigon *via* Dog Lake to a point on the line under construction from Fort William westward, the total length would be, approximately, 661 miles.

These exploratory surveys show that a feasible line, with fair gradients and only a moderate proportion of rather heavy works, can be obtained from South River to Vermillion Lake, 106 miles. But between that point and the high plateau reached at Lake Aux Sables at the 175th mile, the country is not so favourable. The course of the line is tortuous, the rise occasionally abrupt, requiring high gradients, and a considerable proportion of the works would be heavy.

The almost uniform altitude of this plateau or watershed for a long distance on the line explored, and at different points where it has been crossed by previous surveys, suggests the course of avoiding the heavy works on the shore of Lake Superior, by diverging from the present line at some point in the vicinity of Lake Winnibegon, and following the watershed which trends more to the northward, to Long Lake, and there joining the line No. 2 of the survey of 1873. Thence, it follows that line to the crossing of River Nepigon near its outlet from Lake Ellen.

If this were found favourable, we should then have the choice of two feasible lines between the south-east angle of Lake Nipissing and the River Nepigon; one passing the south of Lake Nipissing and the watershed between Lakes Huron and Superior and Hudson's Bay; the other running to the north of Lake Nipissing, and generally north of the watershed.

SURVEYS IN THE CENTRAL OR PRAIRIE REGION.

During the past season, surveys have been made with the view of improving the crossings of some of the rivers and deep ravines in this region, with the following results:—

South Branch of the Saskatchewan; at the 878th mile, from Fort William, Lake Superior

The eastern approach to this river can be improved from a gradient of 0.75 per 100 to one of 0.50 per 100, or 26.40 feet per mile; but the line will be lengthened about a mile and one-third, and the formation level above the bottom of the valley, raised from 88 to 95 feet.

Grizzly Bear Coule at the 1078th mile.

By former surveys, the breadth of the Coule or trough was 2,200 feet at the top, 1,000 feet at the bottom, and 155 feet deep. By the last survey it is 2,400 feet wide at the top, 1,200 feet at the bottom, and 125 feet deep. Neither the rate of the gradients nor the quantity of excavations in the approaches has been increased.

The summit altitude, west of the Coule at the 1087th mile, has been reduced 54 feet, and the gradients have been improved.

Buffalo Coule at the 1101st mile.

The breadth of this, by former surveys, was 1,600 feet at the top, 700 feet at the bottom, and 100 feet deep, which is reduced by the last survey to 1,200 feet at the top, 600 feet at the bottom, and 90 feet in depth.

Suggested deviation of the line from Selkirk westwards, passing south of Lake Manitoba.

In accordance with the verbal instructions of the Minister, an examination has been made of this line, with instrumental surveys of some of the deep valleys traversed by the line, and at other places where deemed necessary.

The deviation from the located line commences at the crossing of the Red River, and takes a south-westerly course till it reaches the centre of the range of townships lying north of the fourth base line; thence it follows due west on or alongside a road allowance through the centre of this range nearly up to the valley of the Little Saskatchewan. Thence, continuing westward, it crosses the Assiniboine at a point above the junction of Qu'Appelle River and through the Touchwood hills to the Elbow of the North Saskatchewan at Caerlaverock.

The line throughout the Province of Manitoba, nearly 100 miles, is very favourable for railway construction, and the land is generally fertile. West of the Province Line the country is more broken, and the land becomes poorer.

The first serious difficulty is the crossing of the valley of the Little Saskatchewan, which is nearly a mile wide at the top, sloping gradually down to the river, where the valley is 225 feet deep. As it is obviously impracticable to cross this at right angles without enormously heavy works, the course of the surveyed line was deflected so as to follow obliquely down one side of the valley and up the other, by which the maximum gradient on the east side was reduced to 0.75 per 100, or 39.60 feet per mile for five miles in length, and on the west side to 1 per 100, or 52.80 feet per mile for a little over four miles in length. Thus it requires over nine miles to cross this valley, carrying the line out of the direct course, which, together with the unavoidable curvature, will increase its length considerably.

The valley of Birdtail Creek, at the point crossed by this route is three-quarters of a mile wide, and 190 feet deep in the centre.

The valley of the Assiniboine is over a mile wide, sloping abruptly down to the bottom flat, which is over 200 feet below the level of the plain. The river is 300 feet wide at flood, where it is crossed by a bridge near Fort Ellisee.

No instrumental survey was made of these valleys, but they could probably be crossed in the same manner as the little Saskatchewan.

The valley of Cut Arm Creek is over 100 feet deep where the trail crosses it.

The Touchwood Hills could be crossed without exceptionally high gradients, but with some rather heavy excavations; and the line would be sinuous, and consequently longer, than if a direct course were practicable.

Thence, to the bend of the North Saskatchewan at Caerlaverock, the country is similar to that traversed by the located line. A large proportion of the land on this line is only fit for pasture, and much of it is sandy or light soil, producing short grass. Among the Touchwood Hills, and in their vicinity, there are some tracts of good land fit for cultivation.

Deviation to Quill Lake.

An alternative line in the same general direction, may be thus described:—Following the course of the last line up to the Little Saskatchewan, it there deflects

to the north-westward, crossing the Assiniboine near the mouth of Shell River; thence, passing to the north of the Touchwood Hills it joins the located line near Quill Lake.

The valley of Bird Tail Creek, where this line crosses, is nearly a mile wide at the level of the plain, and slopes gradually down to the river, where it is 175 feet deep. This could be approached on the east side by a narrow lateral valley, but there is no corresponding valley on the west side.

The valley of Shell River where the line strikes it, is 250 feet deep, over a mile wide at the top, and 1,000 feet on the bottom flat. It is possible to descend by the slope of this valley to the bottom flat of the Assiniboine Valley, and after crossing that, to ascend by a lateral valley to the table land on the west side; this, however, can only be done by using high gradients, and with a large amount of curvature, by which the length of the line would be considerably increased. Some of the gradients used on the survey were 70 feet to the mile; these, however, can probably be reduced to 1 per 100 or 52.80 feet per mile, but only with very heavy excavations.

The rest of the line to Quill Lake is favourable; a considerable proportion of the land is fit for cultivation; of the balance, some is good pasture land, the rest very poor.

It should be observed that the Engineer-in-Chief fixed the maximum gradient at 0.5 per 100 = 26.40 feet per mile rising eastward, and 1 per 100 = 52.80 feet per mile rising westward, and on the located line these gradients have been maintained to a point west of Battleford. They could not, however, be maintained on the line suggested; even with very heavy works a gradient of 1 per 100, each way, is the best that can be had for many miles.

This, together with the increased length caused by curvature and deflections from the general course, would render the line suggested much inferior to the located line for the economic working of the traffic, and would add considerably to the cost of moving to the seaboard the produce of the large and rich agricultural tracts lying further to the north west.

There are no *data* for estimating the difference of the cost of construction in the two lines, but this is a point of less importance than economic working after construction.

Comparing the extent of good lands that would be crossed by the located line and the suggested deviations, the latter have probably the advantage for the first 100 miles, viz., to the western boundary of Manitoba, as the lands of the Province are generally fertile, and in the portion that would be traversed by the lines proposed, they are comparatively dry and free from timber, and are, therefore, eligible for rapid settlement; a good system of drainage, however, is required throughout the Province.

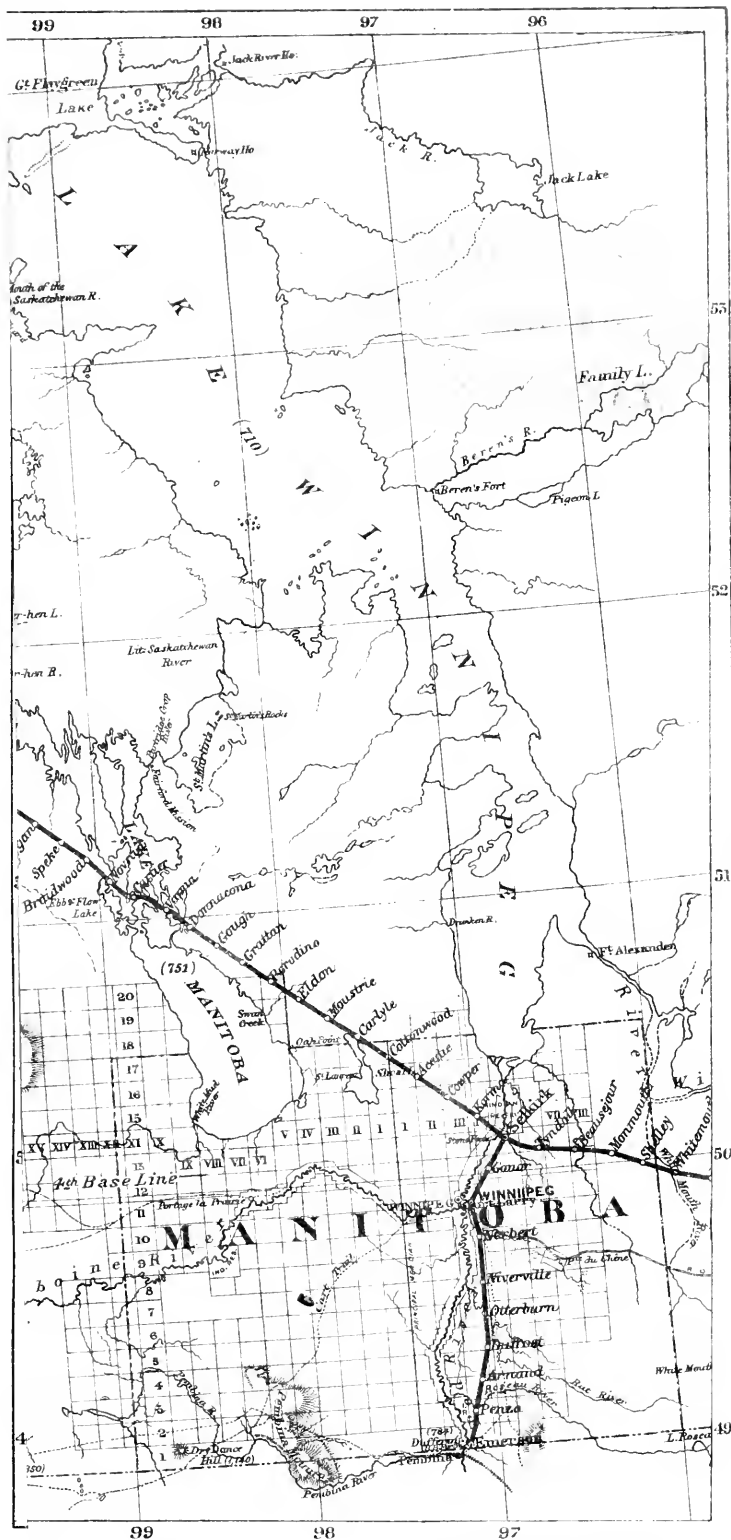
The located line also crosses large tracts of good land; and it should be borne in mind that even the *muskegs* or swamps, which are found on both lines, will make good meadow land when drained, as they are not deep; the side ditches of the railway alone will effect a great improvement in this respect, as they have done elsewhere. There is a considerable quantity of wood lands on the located line, chiefly poplar, which may possibly oppose certain difficulties to settlement, but which undoubtedly offers compensating advantages.

Beyond the first 100 miles from Selkirk there is a long stretch of land, of inferior and variable quality on both lines. But at the valley of Swan River the located line enters on a very extensive fertile tract. On the suggested deviations, after passing the Province boundary, the quality of the land becomes inferior, and only a small proportion is fit for cultivation westward up to the bend of the North Saskatchewan.

On the deviation from the Little Saskatchewan, north-westward to Quill Lake, there are considerable tracts of good land fit for cultivation.

This seemed to indicate that the fertile belt trends to the north-west, and a more extended examination of the country was accordingly made, by which this view was confirmed.

A line drawn from Winnipeg to Fort à la Corne near the confluence of the two



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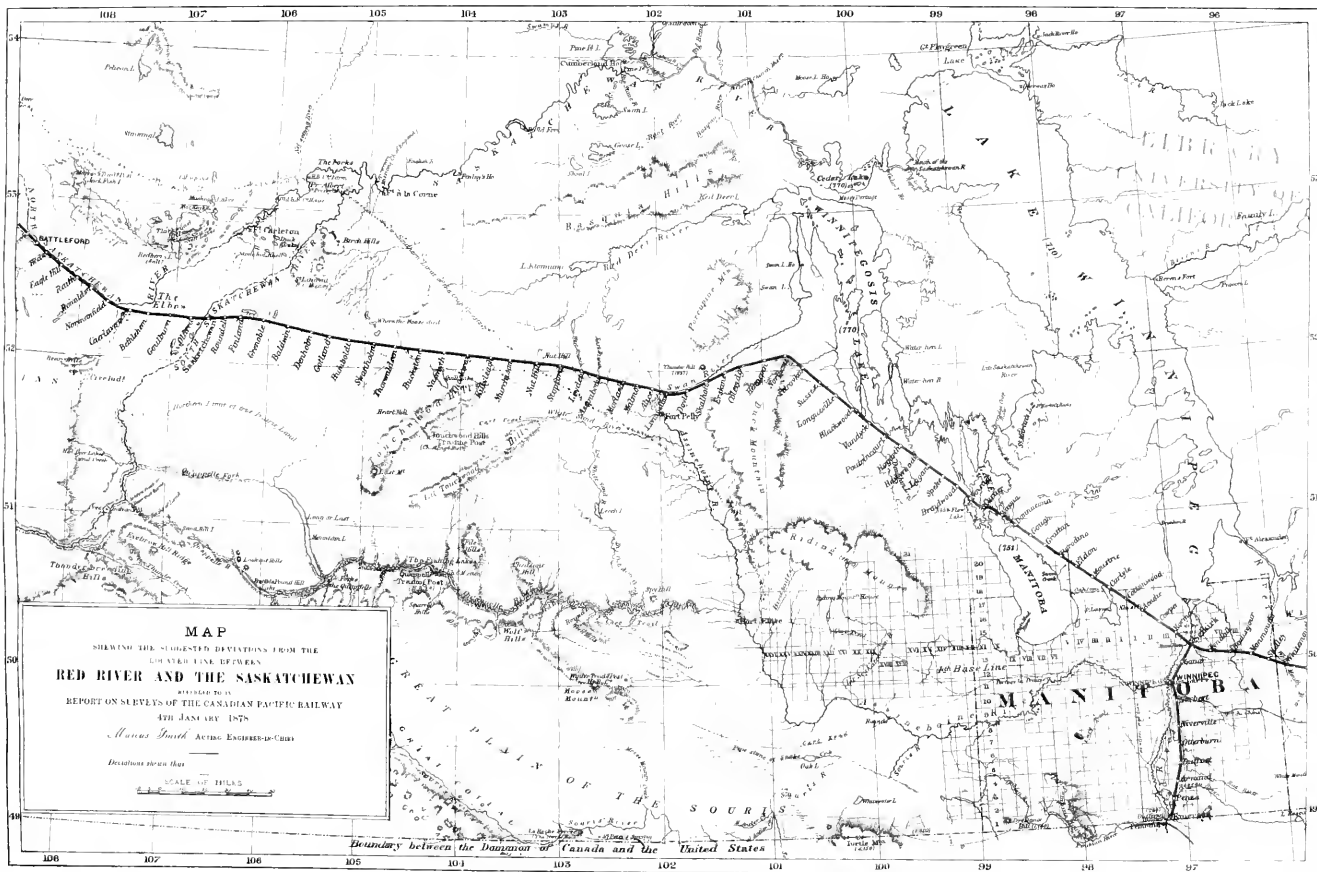
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branches of the Saskatchewan, would cut off the south-west angle of Lake Manitoba, skirt the north-eastern base of Riding Mountain, cross the north end of Duck Mountain, and pass 15 to 20 miles north of Fort Pelly and across the Basquia Hills. If this line were extended through the Beaver Valley to Lac la Biche, thence by the Lesser Slave Lake, so as to intersect the Peace River near the mouth of Smoky River, it would show the general course of the great fertile belt of agricultural lands in the North-West Territory. It is not to be expected that in a stretch of over 1,000 miles the soil will be uniformly good. The fertile belt is accordingly very irregular, often intersected and contracted by *muskegs* and lakes, and low ranges of hills on which the soil is of variable quality; there are, however, vast tracts of extraordinary fertility. Both the quality of the soil and the salubrity of the climate improve towards the North-West; whilst investigations have shown that even beyond Peace River, the productive powers of the land are astonishingly great.

It is evident that no single line of railway can traverse all the fertile portions of a region so extensive, and that even before the trunk line is complete, branches will be required in various directions.

A branch line could be constructed, at a comparatively small cost, to meet the requirements of the Province of Manitoba equally well as a diversion of the main line, which, if carried out as suggested, could not fail to be injurious to the wider interests of the Dominion.

From all the information obtained up to this time, it does not appear advisable that any alteration should be made in the line as located in this district. There, however, appears to be a feasible line, which, after passing the south end of Lake Manitoba, takes a north-westerly course, skirting the eastern base of Riding Mountain and the north end of Duck Mountain, and joining the located line in the valley of Swan River.

The country is described as level and thickly wooded with spruce, poplar and some maple. (*File Report of April 10th, 1872* : Page 56.) Small lakes surrounded by extensive marshes are, however, found throughout this district.

The line suggested would be from 20 to 30 miles longer than the located line, but the gradients would probably be good, and the works moderately light, and it would, therefore, be somewhat less open to objection than the other deviations proposed.

SURVEYS IN THE WESTERN OR MOUNTAIN REGION.

During the season of 1877, the writer travelled over the route from the Saskatchewan, *via* the Yellowhead Pass, and the valleys of the Thompson and the Fraser to the Pacific coast, and closely examined the line at most of the difficult points of the survey. A complete location survey was made of that portion of the line from Tête Jaune Cache to Burrard Inlet, by which some of the difficulties and heavy work met with in former surveys have been avoided or reduced, and the line generally much improved. When the plans and profiles are completed, and the quantities of the several classes of work got out, they will furnish better *data* for making an estimate of the cost of construction than have hitherto been obtained. A description of this survey by Mr. H. J. Cambie is appended.

EXPLORATION OF THE SKEENA ROUTE.

At the outset, it became evident that there is no harbour at the mouth of the Skeena suitable for a railway terminus. A fair anchorage is to be had in Cardena Bay, at the southern end of Kennedy Island, but it would be extremely difficult, if not impracticable, to reach that neighbourhood with a railway line.

Attention was therefore directed to Port Simpson, at the northern end of the Tsimpsean Peninsula, a well known and excellent harbour, and on examination it was found that there are no great obstacles to carrying a line along the north side of the Peninsula to that point.

The distance is probably 10 miles longer than to Cardena Bay, but, of the two, this harbour is far better adapted for commercial purposes, and the cost of constructing the railway would probably be much less.

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Engineering Features.

From Port Simpson, for about 35 miles along the north side of the Tsimpsean Peninsula, and across the dividing ridge, 250 feet high, to the banks of the Skeena, the works would be heavy.

In ascending the Skeena through the Cascade Mountains the works would generally be heavy, but less so than by either the Fraser or Homatheco valleys, through the same chain of mountains.

For the first 35 miles the hills descend in steep inclination to the water's edge, and there are indications of snow slides at several points. The valley averages a mile in breadth, but the river is thickly studded with islands, and has channels washing the base of the mountains on either side.

Above this, for a distance of about 80 miles till the eastern face of the Cascade range is reached, the valley narrows a little, but the side hills are not so steep. The valley then opens out somewhat, and the works would be moderate for about 40 miles, which distance would bring the line to the Forks of the Skeena, near which there is an Indian Village named Kitma on the map.

The elevation at this point is about 700 feet above sea level, and the gradients would be very easy throughout the whole distance from the seaboard.

The general course of the line up to this point has been north-east, but here it leaves the Skeena and takes a south-east course at right angles to the former, ascending the valley of the Watsonquah, which for the first 27 miles is principally a canyon, and would require stiff gradients and heavy works in places.

The remainder of the distance, *via* Lake Fraser to the valley of the Nechaco, would have easy gradients with moderately light works. The summit altitude between the Skeena and Nechaco, is only 2,400 feet above sea level. In this valley a junction is made with the previously surveyed line from Yellowhead Pass. (*Vide* Report, February 8th, 1877, pages 274-276.)

Several attempts were made to find a pass leading directly from the Skeena to Lake Francois, so as to avoid the angle between the former and the Watsonquah, and so greatly reduce the length of the line, but without success, as the space contained within the angle is a compact mass of high mountains.

The distances from a common point at the mouth of the Chilacoh, near Fort George, are as follows:—

	Miles.
To Port Simpson, approximately.....	430
To Bute Inlet, by measurement.....	289
To Dean Inlet, by measurement.....	231

Port Simpson is, however, much nearer to the Asiatic coast, the distances to Yokohama being as follows:—

	Statute Miles.
From Port Simpson.....	4,450
From Kamsquot Harbour, Dean Inlet.....	4,720
From Waddington Harbour, Bute Inlet.....	4,836

Character of the soil, &c.

There is a small area of land in the neighbourhood of Port Simpson fit for cultivation. In the lower part of the Skeena, many of the islands with which it is studded, consist of rich alluvial soil, but they are subject to overflow at high water. For 15 or 20 miles below the Forks of the Skeena, and for some distance above that point, the hills do not approach the river within two or three miles on either side. The land is of fair quality, and covered with a light growth of poplar, birch and spruce. There are some settlements at the Forks of the Skeena, where there was a fine crop of oats, almost ripe, on the 31st July, and also abundant crops of potatoes, carrots, cabbage, &c.

The slopes of the Watsonquah Valley throughout its length are, in part, prairie and sustain a magnificent growth of grass fit for pasture. The roots of the grass

intertwine and form a sod, so that it would not be killed off by allowing cattle or sheep to crop it closely, as bunch grass is.

This part of the country is, however, subject to summer frosts, which would render it unfit, or at least unreliable, for purposes of agriculture.

Timber.

A tree commonly called "yellow cypress" is found on the Lower Skeena, which has great strength and density of fibre, and is said to be extremely durable, but the quantity is so limited that it may be said to have little commercial value. The same remark would apply to hemlock, though it was seen in some places of great size. On most of the islands subject to overflow, very fine cottonwood trees are to be found, which may be utilized at some future time for the same purpose to which basswood and whitewood are applied in the Province of Ontario.

Snow Fall.

Through the Cascade Mountains, the snow in places lies to a depth of seven or eight feet on the level. From the Forks of the Skeena to the River Fraser it is said not to exceed three feet in depth, except on very rare occasions.

Minerals.

Marble was seen in beds of great thickness, varying in color from purple to white. Some ores of copper and lead were also observed, but not in veins of any great thickness.

EXPLORATION OF PINE RIVER PASS.

The highly favorable reports received respecting the character of the Peace River District, and the prospects held out of a satisfactory route being obtainable through the Pine River Pass, made it expedient to obtain further information in that direction. Accordingly, the exploration was extended from a point in the neighbourhood of Lake Fraser, *via* the east end of Lake Stewart, to Fort McLeod on the Parsnip or south branch of the Peace River.

This route proved very unfavourable for railway construction; subsequently, however, a good connecting line, though more circuitous, was found by following down the Nechaco and the Stewart Valleys nearly to Fort George; thence in a northerly direction up the valleys of the Fraser and Salmon Rivers, and across the low water shed to Summit Lake, one of the sources of the Parsnip, which river was then followed down to Fort McLeod.

Beyond the existence of an Indian trail across the Rocky Mountains from Fort McLeod to Fort St. John, very little was known; nor was any information obtainable in the neighbourhood respecting the Pine River Pass, except through an old Indian woman, who drew a sketch on the sand and explained it to the best of her ability.

With the scant information thus obtained, the exploration was continued from Fort McLeod eastward: following up the valley of the River Misinchinca, an affluent of the Parsnip, till an altitude of 5,500 feet was reached without any appearance of a Pass. On descending the river, a stream was discovered running into it from the north, about 35 miles above its confluence with the Parsnip. Following this up four miles, it was found to issue from a small lake named Azazetta. This proved to be near the summit of the Pine River Pass, its altitude being estimated at 2,430 feet above the level of the sea.

A little beyond this the head waters of the Pine River were struck, and the river followed down eastward to the Forks, a point reached by Mr. Selwyn with a canoe from the Peace River in 1875. (*Vide* Geological Survey of Canada, Report of Progress for 1875-76, pages 52 to 54.)

The exploration was continued 30 miles eastward of the Forks on to the Beaver Plains, which lie between the Rocky Mountains and Peace River.

Thus the question of the feasibility of the Pine River Pass is at last solved.

The full Report has not yet been received, but the distance between Fort McLeod on the west side of the mountains, and the Forks of Pine River on the east side, is roughly estimated at 90 miles.

The gradients are stated to be generally easy, with the exception of about four miles near the summit of the Pass, where they will probably be about 60 feet to the mile, and the works in the construction of a railway would be moderately light, except for a length of about eight miles near the summit of the Pass, and a short length at the Forks of Pine River where they would be heavy.

The land in the Pine River Valley, for 50 miles above the Forks, is described as of excellent quality and well suited for agricultural and grazing purposes.

It should be observed that this fertile strip of land, lying nearly in the heart of the Rocky Mountains, is an extension of the Beaver Plains which connect with the great fertile belt stretching from Manitoba to and beyond the Peace River.

Should the engineering character of a line by this route prove, on closer survey, as favourable as reported, the results from this exploration will be amongst the most important that have been obtained since the commencement of the surveys. Some of the serious difficulties in crossing the Rocky Mountains will have disappeared, and this formidable chain, once held to be insurmountable, and even now felt to be a grave obstacle to railway enterprise, can then be passed with very favourable gradients, and with works not exceeding in magnitude those generally required on other portions of the line.

In addition to the manifest advantages offered by this route, there is, further, the important consideration that in the place of a bleak, sterile country, wherein settlement is an impossibility for hundreds of miles, the line would traverse an area of remarkable fertility with but a few short intervals of country unfit for settlement. This route also passes between the vast mineral districts of Omineca and Cariboo. The extraordinary results of recent mining operations in the latter give promise, when their resources are more fully developed—as they can only be with the assistance of direct railway communication—of rivalling, if not surpassing, the far-famed gold and silver regions of the neighbouring States, which lie in the same mountain zone.

Port Simpson may possibly be considered, at present, too far north for the terminus of the Canadian Pacific Railway, but it is important that the fact should be borne in mind that, by virtue of low altitudes and consequent easy gradients, together with the comparatively moderate character of the works required to reach it, this terminal point offers advantages which would enable a Canadian line to defy competition for the trade with China and Japan, Port Simpson being fully 500 miles nearer to Yokohama than Holme's Harbour, at the mouth of Puget Sound, the proposed ultimate terminus of the Northern Pacific Railway, while the advantage it possesses over San Francisco is correspondingly greater.

But the Pine River Pass is not merely the key to Port Simpson; it affords comparatively easy communication with Bute Inlet, and all the intermediate inlets between that point and Port Simpson, the valleys of the rivers leading to these inlets radiating from the Stewart Valley, south-west of the Pass, with exceptional directness. Thus many of the difficulties in the way of reaching Bute Inlet and the inlets to the north of it, *via* the Yellowhead Pass, can be avoided, and this probably without increasing the length of the line.

The distance from Livingstone on the located line, over the Yellowhead Pass to the confluence of the Chilacoh and Stewart Rivers, near Fort George, is 1,029 miles. The distance between the same points *via* the Pine River Pass, measures on the map so nearly the same as the above, that a survey alone can determine the precise difference between the two routes.

WORKS OF CONSTRUCTION.

TELEGRAPH LINE.

Commencing at Fort William, the line is erected to a point named "Faleon," a distance of 137 miles, and is in operation to English River, 113 miles. Between Faleon and Keewatin, 160 miles, considerable clearing has been done, and a line erected for a distance of 30 miles eastward from Keewatin. Between Keewatin and Selkirk, 112 miles, the line is erected and in operation. It is expected that the connection between Fort William and Selkirk will be completed during the winter.

The line is erected and in operation between Selkirk and Livingstone, 271 miles, but where it crosses certain lakes, ponds and marshes, a number of the poles require to be more permanently secured. The branch line between Selkirk and Winnipeg, a distance of 22 miles, is completed and in operation.

The line is erected, and has been operated from Livingstone to a point in the longitude of Fort Edmonton. There is still, however, a considerable amount of clearing to be done, some inferior poles to be replaced, and some portions to be altered. At present, it is only in operation as far as Battleford.

On the western Section, between Edmonton and the existing line in British Columbia, no portion of the line is completed, but a quantity of material has been delivered at points along the route.

GRADING, TRACK-LAYING, &C.

Fort William to English River 113 miles.

From Fort William, westward, the roadbed of the railway is graded continuously, and the bridges erected to the 77th mile; beyond this point there is an aggregate of four miles more graded in detached portions. The rails are laid for a distance of 41 miles, and of this about 36 miles are partially ballasted, and in fair running order.

English River to Keewatin (Rat Portage,) 184 miles,

The line has been located for construction between these points, but is not under contract.

Keewatin to Cross Lake, 36 miles.

From Keewatin, westward, for a distance of 25 miles, a considerable quantity of excavation has been done, consisting chiefly of rock. From the 25th to the 36th mile supplies are being delivered, but grading has not been commenced.

Cross Lake to Selkirk, 76 miles.

From Cross Lake, westward, for a distance of 11 miles, there has been no grading done. From the 11th to the 43rd mile the grading is in various stages of progress, 17 miles of the distance, in detached portions, being ready for tracklaying. From the 43rd to the 76th mile the grading and bridging are completed, and the roadbed is in good condition for tracklaying. The rails are laid, but not ballasted, for a distance of 6 miles eastward from Selkirk.

Pembina Branch.

The length of this branch is $84\frac{1}{2}$ miles, extending southward from the main line at Selkirk to the International Boundary at Emerson. Between Selkirk and St. Boniface, opposite Winnipeg, a distance of 22 miles has been graded during the past summer, and the rails laid over the same, but it is not ballasted. From the 22nd to the 29th mile, no grading has been done. From the 29th mile to Emerson, the grading was completed in 1875, with the exception of the spaces left for bridges and approaches.

ENGINE HOUSE.

A ten stall engine house has been completed at Fort William,

ENGINEERS' HOUSES.

At Fort William a good house has been built for the District Engineer, and between that point and Selkirk, 18 smaller houses have been erected for the use of the Assistants on the line during construction, which, after the line is opened for traffic, will come into use in connection with the stations.

FORT FRANCES LOCK.

The rock excavation is nearly completed. The timber for the gates will be procured during the winter. For description of this work, *vide* Report of 1876. Appendix, p. 205-208.

CONTRACTS.

A schedule of contracts, with statement of expenditure upon the same during the fiscal year ended 30th June, 1877, is appended.

I have the honour to be, Sir,
Your obedient servant,

MARCUS SMITH,
Acting Engineer in Chief.

CANADIAN PACIFIC RAILWAY.

SCHEDULE OF CONTRACTS with Statement of Expenditure upon the same, during the Fiscal Year ended 30th June, 1877.

Contract No.	Character of works.	Date of Contract.	Name of Contractors.	Amount expended during Fiscal Year ended 30th June, 1877.
		1874.		\$ cts.
1	Construction of Telegraph Line, Fort Garry to Livingstone.....	Oct. 17.....	Sifton, Glass & Co.....	35,780 80
2	do do Livingstone to Edmonton.....	do 30.....	R. Fuller.....	32,414 95
	do do Edmonton to British Columbia.....	Nov. 10.....	F. J. Earnard.....	8,900 00
	do do Lake Superior to Fort Garry.....	1875. Feb. 19.....	Oliver, Davidson & Co.....	40,927 66
		1874.		
5	Pembina Branch { Grading } { Extension St. Boniface to Selkirk, Grading, Bridging } { and Tracklaying }	Aug. 31.....	Joseph Whitehead.....	{ 13,298 00 399 00 }
13	Fort William to Sunshine Creek, Grading and Bridging.....	1875. April 3.....	Sifton & Ward.....	114,100 00
14	Red River to Cross Lake, Grading and Bridging.....	do 3.....	Sifton & Ward.....	130,470 00
	{ Cross Lake to Rat Portage, Grading and Bridging..... } { Red River, to Rat Portage, Tracklaying and Ballasting..... }	1877. June 9.....	Sutton, Thompson & Whitehead.....	54,300 00
23	Railway Sleepers, No. 56,329.....	1875. Oct. 4.....	Sifton & Ward.....	3,669 79
25	{ Sunshine Creek to English River, Grading and Bridging..... } { Fort William to English River, Tracklaying and Ballasting..... }	1876. June 6.....	Purcell & Ryan.....	335,800 00
26	Ten Stall Engine House, at Fort William.....	July 17.....	James Ishester.....	16,600 00
29	Railway Spikes, 150 Tons, delivered at Fort William.....	do 28.....	Cooper, Fairman & Co.....	8,552 90
32	Railway Spikes.. { 200 tons delivered at Duluth..... } { 59 do Fort William..... }	1877. May 12.....	Cooper, Fairman & Co.....	13,617 50

APPENDIX B.

REPORT ON THE LOCATION SURVEY FROM YELLOWHEAD PASS TO BURRARD INLET, BY
H. J. CAMBIE, ENGINEER IN CHARGE OF SURVEYS, BRITISH COLUMBIA.

OTTAWA, 23rd April, 1878.

SIR,—On the 19th December last, I prepared a report giving a description of the trial location survey of the line from Yellowhead Pass to Burrard Inlet, made during the summer of 1877.

The plans and profiles having since been completed, I am thereby enabled to revise that report as follows:—

From the summit of the Yellowhead Pass to the 38th mile, westward, the line descends the valley of the Fraser River, and, so far, it is common to all the routes through British Columbia.

Point of divergence to Cranberry Lake, 38 to 58 miles.

The line continues to follow the valley of the Fraser, in a westerly direction, to about the 46th mile, near Tête Jaune Cache, when it turns sharply to the south, up the Cranberry Valley, to the lake of the same name. As laid out, it is nearly level, till it enters the Cranberry Valley, and then falls gradually to the lake, by which the descent is distributed over a long distance. For the first eight miles it is high up on the mountain side, which is very steep; much curvature is required, and the works are in rock, and very heavy.

For the remainder of the distance the curvature is easy, and the excavations are in gravel, two miles being heavy and about ten light.

McLennan's Creek, 100 feet wide, is the only large stream to be crossed.

Cranberry Lake to North Thompson, 58 to 85 miles.

At the 58th mile, the line crosses Cranberry Lake, which is 4,000 feet wide, and from 5 to 7 feet deep,—thence continuing in a southerly direction, it crosses the Canoe River, a tributary of the Columbia, at the 61st mile, and ascending the valley of the Camp River, to the 71st mile, there passes over a summit 2,880 feet above sea level, and enters the valley of the Albreda Lake and River, whose waters flow, *vid* the Thompson and Fraser Rivers, into the Strait of Georgia, about ten miles south of Burrard Inlet, and the line follows the valleys of those rivers all the way to the last mentioned place. Surveys were made around both ends of Cranberry Lake, but rejected for economical reasons. The work thence to Canoe River, 3 miles, is heavy.

Between the 80th and 82nd miles the Albreda falls rapidly, and then flowing gently, joins the Thompson at the 85th mile. In order to keep the gradient within a maximum of 1 per 100, the line is located on steep side hill for about 4 miles, with numerous curves of 1,146 feet and 1,433 feet radius and heavy works.

If it were permitted to introduce a steeper gradient for a short distance, and so keep the line in the bottom of the valley, it is probable that the curvature could be eased and the works much reduced without lowering the efficiency of the line materially.

Of the works on the remaining twenty miles, four may be classified as heavy and sixteen ranging from medium to light. The material is principally sand, gravel and boulders.

North Thompson Valley, 85 to 102 miles.

Near the eighty-fifth mile the line crosses the North Thompson River, 300 feet wide, and then follows its right bank. Being to a large extent on the hillside many

curves were required, and four of 820 feet radius were used; but at such places the gradients are trifling, and are throughout undulating and easy.

The work varies from medium to heavy, with the exception of one point near the eighty-sixth mile, where the main mountain abuts on the river, causing it to be excessively heavy.

Crib wharfing will be required at several places for protection against the Thompson River.

North Thompson Valley, 102 to 120 miles.

For the first four miles the line is on benches requiring heavy work. From that point forward it is on flats, and the work is light except at a few places where the base of the hill is washed by the river, causing some rock spurs to be cut through. The principal streams to be bridged are—Green River, 75 feet, and Blue River, 100 feet wide. The grades are light and undulating, and curvature easy.

North Thompson Valley, 120 to 130 miles.

This section is all on side hills and embraces the canyon of the North Thompson four miles in length. The works are generally in rock, and for six miles are very heavy, with two tunnels—one of 350 feet and one of 150 feet long. Although the descent through the canyon is rapid, only $1\frac{1}{2}$ miles of 1 per 100 grade will be necessary. The sharpest curves are 1,146 feet radius. No large streams are met.

North Thompson Valley, 130 to 143 miles.

This section is on the flats adjoining the stretch of river known as Stillwater, which is subject to overflow when the river rises in June or July, and will require some protection. Two rock spurs and one of gravel have to be cut through; the rest of the work is almost exclusively embankment, and not heavy. No large structures are required. The grades and curves are light.

North Thompson Valley, 143 to 164 miles.

Six miles of this are on side hills and require heavy work, one-third of which is in rock; the remaining 15 miles are on benches and flats, with medium work principally in gravel and boulders. Several places have to be protected against encroachment of the river, and two points between the 160th and 162nd miles against earth sliding from above in the Spring.

The grades are undulating with four stretches of one per 100, the longest of which is $1\frac{1}{2}$ miles. To avoid tunneling a curve of 716 feet radius was used, on a grade of 26 feet per mile. Mad River, 60 feet wide, is the only stream of consequence to be crossed.

North Thompson Valley continued to Clearwater, 164 to 182 miles.

Of this distance there are about four miles on steep side hill close to the river and require protection in many of the bays. There are about six miles of heavy work, principally in sand, gravel and loose rock; the rest is light. Near the 171st mile the line crosses the North Thompson to its eastern bank, which is then followed to Kamloops. This crossing is 350 feet wide; and no other river of importance is met with on this section. The grades are undulating and easy, and the curvature is not serious. By crossing to the left bank of the Thompson, near the 155th mile, the sliding clay near the 160th and 162nd miles, and some of the river protection would be avoided; but without a survey it is difficult to form an opinion as to which line would be best.

From the summit of the Yellow Head Pass to Clearwater the valleys through which the line is located are either in the Rocky Mountains proper or among some of the outlying spurs of that range, which induces a large rainfall, and the country is therefore covered with a dense growth of timber, principally hemlock, cedar, fir and spruce, with much underbrush. To the westward of the Clearwater, however, there is a marked change in the climate and vegetation. The rainfall decreases very much; the timber becomes scattered; bunch grass, sage and cactus appear on the hill sides.

Clearwater to Indian Reserve, 182 to 206 miles.

Assiniboine Bluff and some other side hills about on this part of the river, and cause about eight miles of heavy work, a large proportion of which is in rock. The other 16 miles may be classified as medium work. Curves and grades are easy. No large streams have to be crossed.

Indian Reserve to Head of Rapids, 206 to 220 miles.

Most of this distance is on the flats next the river, where work is light; $2\frac{1}{2}$ miles of heavy work occur in clay, sand and gravel. Some river protection is required. The only large stream to be bridged is the Barrière, 350 feet wide. The curves are easy and grades light.

Head of Rapids to Kamloops, 220 to 255 miles.

This section includes two side hills, one five miles and the other $3\frac{1}{2}$ miles long, on which the work is heavy. The rest varies from medium to light. Near the 254th mile the South Thompson, 500 feet wide, is crossed close to its confluence with the North Thompson. The grades and curves are light.

Kamloops to Savona's Ferry, 255 to 280 miles.

From Kamloops the line follows the Thompson River for seven miles, with easy work and gradients, to Kamloops Lake.

In following down the south shore of the lake, Cherry Creek Bluff and some others of bold irregular outline have to be passed, entailing ten tunnels of a total length of 4,475 feet, principally in rock, all of it heavy—and eight miles of it excessively so. In passing the bluffs it was found necessary to use curves of 955 feet radius, and gradients of 1 per 100 are of frequent occurrence. No large streams have to be crossed.

Before the survey was commenced, the Thompson River was examined from the Clearwater to Kamloops, with a view to deciding whether it would be better to have the line located on substantially the same line surveyed in 1872, which crossed the Thompson River a little above Clearwater, and continued on its left bank to Kamloops, or to follow down its right bank and cross the main Thompson River between Kamloops and Kamloops Lake.

The latter line would be the shorter of the two, but that advantage was considered to be more than counterbalanced by the increased length of bridging, and the line was therefore located down the left or eastern bank.

It is still, however, possible that a better line could be had by continuing down the right bank, keeping on the north side of Kamloops Lake and crossing the Thompson River a short distance below Savona's Ferry; for, by adopting that line, or a modification of it, the distance would be shortened about three miles. Battle Bluff, on the north side of Kamloops Lake, would have to be encountered, which is a formidable obstacle, but might, on a closer examination, prove to be even less so than Cherry Creek Bluff, on the south side of the lake. The relative merits of the two lines can only be decided by a survey.

Savona's Ferry to foot of Black Canyon, 208 to 308 miles.

Of this distance six miles may be classified as light work. All the rest is on the face of benches adjacent to the River Thompson, causing heavy work which requires protection from wash at many points. The proportion of rock work, however, is not large. Near the 307th mile a ridge of rock forming a sharp bend in the river necessitates a tunnel 550 feet in length. No large streams have to be crossed. Curves of 1,146 feet radius were frequently used. The grades are undulating and short, requiring in several instances 1 per 100.

Foot of Black Canyon to Spence's Bridge, 308 to 327 miles.

This section is partially similar in character to that last described. Through nearly half of it the work is of a light character and the balance heavy, requiring river protection at many places. There is but little rock excavation.

The curves are numerous, 955 feet radius being the sharpest. The grades undulate.

Near the 326th mile the River Nicola, 300 feet wide, has to be bridged. The Thompson River, throughout its entire length, is subject to freshets, which usually occur between May and July, when it exceeds its winter level by 10 or 12 feet. But as the ice breaks up and passes off in March or April, when the water is still at a low stage, no danger need be anticipated from this source.

Spence's Bridge to Lytton, 337 to 350 miles.

The valley of the Thompson River for most of the distance is narrow, and the line is located along the face of the steep side hills, advantage being taken of benches at a few points where available. The work may be classified as heavy, with a large proportion in sand gravel and boulders. The River Nicomen, 150 feet wide, and a few rocky ravines, are the only places requiring structures of importance. Several curves of 1,146 feet radius and two of 955 feet radius represent the heaviest curvature. The grades are undulating and easy, there being but one mile of 1 per 100. The worst feature on this section occurs near the 333rd mile, and is known as the *Mud Slide*. It commences at a height of 1,900 feet above the line and about two miles distant, and extends down the mountain side to the Thompson River where it terminates abruptly in a bank about 1,000 feet in length and 40 feet in height. At the point where crossed by the line, it is 1,000 feet wide, and the average forward movement per annum is about eight feet at the centre, decreasing gradually towards the sides. It is apparently caused by springs near its source, which disappear into the ground, reappearing, at intervals, causing the earth, which is strongly impregnated with alkali, to dissolve to the consistency of soap, thus forming a lubricator between the bed-rock and the mass of earth above. By careful drainage of these springs near their source, and diverting them elsewhere, the slide can doubtless be so far stopped as to cause but little inconvenience.

Lytton to crossing of the River Fraser, 350 to 356 miles.

The line descends gently on sand and gravel benches, with heavy work and much curvature for $5\frac{1}{4}$ miles. It then crosses over to the right bank of the River Fraser and continues down that side all the way to Burrard Inlet. The crossing of the Fraser is 500 feet wide at formation level and about 120 feet above low water mark, and can be bridged by one span of 275 feet, the abutments of which can be founded on rock ledges several feet above the river at its low-water level.

Immediately after passing the river, and on the same straight line, there is a tunnel 600 feet long through a rock bluff.

The dry country referred to as commencing near the 182nd mile continues to this point in a greater or less degree. It is especially marked between Kamloops and Spence's Bridge, where the country is sparsely timbered; and with the exception of bunch grass (which is peculiar to dry climates) nothing can be produced without irrigation.

Crossing of River Fraser to Boston Bar, 356 to 379 miles.

The work is heavy throughout this section, being in rock for upwards of one-third of the distance. The Nah-latch River, 120 feet wide, and about twelve large ravines have to be crossed. The curves are numerous, but none shorter than 1,146 feet radius. The grades undulate, and the maximum 1 per 100 has often to be used.

Boston Bar to Yale, 379 to 403 miles.

At Boston Bar the line enters the Canyons of the River Fraser, which extend to Yale. Five miles of the distance is over benches with medium work, and the rest on a broken rocky side hill or along the face of almost perpendicular bluffs, entailing heavy rock excavation; and 13 tunnels, the united length of which is about 5,650 feet ($=1.07$ miles), the longest being 1,550 feet. The largest streams on this section are the Skuzzy, 80 feet, and the Spozzum, about 100 feet wide, and three other

smaller streams. There is one curve near Yale of 820 feet radius on a level; with this exception, 1,146 feet is the shortest radius used. The grades undulate, and there are about seven miles of one per 100. Near the 384th mile is a ravine down which snow sometimes slides, but as the grade is high, and provision has been made for a bridge at this point, the snow can pass underneath without danger to the superstructure.

Yale to Sister of Rocks, 403 to 413 miles.

The work is moderate, being chiefly on gravel benches, with easy undulating gradients, and a small percentage of curvature, five creeks have to be bridged which vary in width from 40 to 100 feet.

Sister Rocks to Flat below Hope, 413 to 419 miles.

From Sister Rocks for a distance of six miles to a flat three miles below Hope, the work is heavy, with a considerable number of sharp curves on undulating gradients principally 1 per 100. There are three short tunnels, amounting in the aggregate to 1,275 feet.

Flat below Hope to Harrison River, 419 to 444 miles.

The work on this section is moderate, four-fifths being on benches and flats, and the remainder along bluffy and broken side hill, with one tunnel 230 feet in length; one creek 100 feet wide has to be crossed. At the time of high water the toe of embankments will be subject to flood at several points, but no apprehension need be felt as to stability of line, as these banks will be of rock, and in no case subject to wash.

Harrison River to St. Mary's Mission 444 to 462 miles.

Eleven miles of this work varies from medium to heavy, with a small proportion of rock; the other seven miles are on a low flat, liable to an overflow at extreme flood of from three to twelve feet, entailing heavy works. The principal streams to be bridged are the Harrison with a waterway of 900 feet, and an extreme depth of 27 feet, the Hatzie 1,460 feet wide varying from 6 to 14 feet in depth, and one other stream 100 feet wide. The grades are undulating and curves easy.

St. Mary's Mission to Pitt Meadows, 462 to 482 miles.

This section of the line is generally close to the northern bank of the Fraser River, five miles of it may be classified as medium, the remaining distance heavy with little rock. Stave River, 1,000 feet wide and 20 feet deep at the centre with Kanaka Creek, 400 feet wide, are the largest rivers to be crossed. The alignment and grades are easy.

The country was explored for some distance back to ascertain the practicability of carrying the line in rear of some partially detached hills which abut on the river, by which the line would be shortened considerably, and some extensive works of bridging and protection avoided. It was found, however, that the hills above referred to were connected with the range of mountains in their rear by high ridges which rendered it impossible to locate a line there with moderate grades.

Pitt Meadows to Port Moody, 482 to 493 miles.

This section includes the Pitt Meadows, which are four miles wide, and subject to an overflow at extreme flood of about 7 feet in depth, requiring expensive works of construction. The remainder of the work varies from medium to light, without rock excavation, so far as known. Where the line crosses the River Pitt it is 1,000 feet wide, and varies from 5 to 45 feet in depth. The Coquitlam, 200 feet wide, is the only other stream of importance. The curves are easy and the grades light.

The head of Port Moody is reached at 491½ miles, but that place being unsuited for wharves owing to large mud flats which are left dry at low water for a considerable distance from the shore, the line was continued to the 493rd mile, where such objections do not exist.

To extend the line from Port Moody along the southern shore of Burrard Inlet to Coal Harbour, which is just inside the entrance, the distance is 12 miles, and to English Bay, three miles additional. On this section some rock spurs extend to the waters edge, entailing some heavy cuttings.

The grades are easy and curves light. From the foregoing it will be observed that 1 per 100 is the maximum gradient used, and that some of the heaviest works met with in the exploratory surveys have been considerably reduced, the aggregate length of tunnelling being now $2\frac{1}{2}$ miles. A considerable portion of these reductions, however, have been effected by introducing more curvature and sharper curves at a few points than had heretofore been employed, one of these being 716 feet radius, and several 820 feet radius, but they were used only in localities, where the line is level or the gradients of trifling ascent. It is probable that a revised location in many places would show an improved line with a considerable reduction of the works.

In passing the Cascade Mountains on this route the ravine near the 38th mile, already referred to, is the only place where snow is now known to slide from any considerable height across the proposed line of railway, heavy drifts occur at various points where the configuration of the ground favours their formation, and will entail the construction of snow sheds. The hill sides were carefully examined for traces of avalanches, but none were found, and this result was corroborated by the testimony of people residing in the neighbourhood, who travel the road continually. No damage, therefore, need be anticipated from this source. On that portion of the line, however, in the Fraser Valley, above Tête Jaune Cache, the mountain sides are very steep and are grooved at places by avalanches of snow, timber and loose rock.

Grades.

Annexed is a table of gradients from the summit of Yellow Head Pass to Port Moody, from which it will appear that 185 miles are practically level, a portion being on grades of 5 feet per mile or less. Ascending eastward there are 66 miles of gradients ranging from 43 to 52.80 feet per mile, $9\frac{1}{2}$ miles of which are included in the first 38 miles, and are, therefore, common to all routes through British Columbia.

Between the 38th mile and Port Moody the longest stretch of 1 per 100 or 52.80 feet per mile ascending eastward, is $3\frac{1}{2}$ miles, and the longest ascending westward is $2\frac{3}{4}$ miles.

Lest the large number of grades ascending westwards should convey a wrong impression, a diagram has been prepared on a scale of 10 miles to the inch, horizontal, and 500 feet vertical, by which it will be seen that these undulations are in many cases so short that the impetus acquired before reaching the foot of the grade will carry a train most of the way up it.

Bill of Works.

The accompanying bill of works includes everything considered necessary to complete the railway to formation level, with iron bridges and durable structures similar to those on the Intercolonial line.

Through that portion of the interior plateau before described as subject to a very limited rainfall, the gravel cuttings have, in many instances, been estimated with slopes of 1 to 1, which is considered sufficient to render them safe in the arid district where they occur; the natural slopes of the same material in this district being much steeper.

I have the honour to be, Sir,
Your obedient servant,

H. J. CAMBIE,
Engineer in charge of Surveys in British Columbia.

SANDFORD FLEMING, Esq., C.M.G.,
Engineer-in-Chief Canadian Pacific Railway.

CANADIAN PACIFIC RAILWAY.

BRITISH COLUMBIA DISTRICT.

ROUTE NO. 2.—492 $\frac{6}{10}$ miles.*Bill of Works, Permanent Structures.*

Description.	Approximate quantities.
Clearing	Acres 5,500
Close cutting	" 240
Grubbing	" 170
Fencing	Rods 56,600
Cattle guards	Pairs 38
Solid rock excavation.....	Cubic yards... 3,294,000
Loose "	" 1,687,000
Earth excavation	" 23,159,000
" in stream diversions.....	" 142,000
" in foundations	" 59,000
Under drains.....	Lineal feet... 22,000
Masonry, first class.....	Cubic yards... 104,450
" second class.....	" 119,300
Paving.....	" 26,000
Masonry in retaining walls	" 154,000
Bridge spans, 275 feet clear.....	Number 1
" 200 "	" 15
" 150 "	" 5
" 100 "	" 108
" 80 "	" 3
" 60 "	" 9
" 50 "	" 18
" 40 "	" 15
Line tunnels, in rock	Lineal feet... 13,855
Stream tunnels, 12 feet diameter.....	" 500
" 8 "	" 500
" 6 "	" 812
Crib wharfing, 12 to 15 feet high.....	" 22,000
" 6 to 10 "	" 15,400
Rip-rap	Cubic yards... 114,000
Timber in culverts, 16×12.....	Lineal feet... 10,000
" 16×8.....	" 7,400
" 16×6.....	" 5,000
" 14×12.....	" 2,000
" 12×8.....	" 1,400
Timber flatted to 12 inches	" 1,000
" 6 inches	" 4,000
Plank.....	B'd Measure . 100,000
Wrought iron in beam culverts.....	Lbs 10,000
" in trestles	" 136,800
Cast iron in culverts and trestles.	" 4,000
Deviations of waggon road....	Miles 7
Bridge for "	Number 1
Under crossings.....	" 4

APPENDIX C.

EXPLORATION FROM PORT SIMPSON VIA THE RIVER SKEENA TO FORT GEORGE
BY H. J. CAMBIE, IN THE YEAR 1877.

(*Memorandum.*)

OTTAWA, April 23rd, 1878.

No harbour was found at the mouth of the River Skeena suitable for a railway terminus.

Fort Essington, which is situated about 14 miles up the river, has been used by small coasting steamers, but is liable to the following objections:—

About seven miles below that place the Skeena is divided by McGrath and Kennedy Islands into three channels.

The northernmost is tortuous, and contains reefs of rock which unfit it for navigation; the central is very shallow, while the southern has only about two fathoms of water when tide is out. Were it even practicable to reach Port Essington with large vessels, it was ascertained from three traders who have each resided at the mouth of the River Skeena for upwards of six years that that port is unsafe as a harbour during the months of December, January and February, and sometimes even longer, owing to the heavy masses of ice which drift up and down with the tide.

This ice is principally from an inlet named the Eekstall which branches from the Skeena about half a mile above Port Essington and extends S.S.E. for about 40 miles into the mountains. It has numerous flats when the tide is out; the water is almost fresh, with very little current, and a rise and fall of tide exceeding 20 feet. Heavy snow storms during cold weather in such a locality cause blocks of ice to increase rapidly in thickness and attain such a size and weight as to endanger shipping and stop navigation.

There is fair anchorage in Cardena Bay at southern end of Kennedy Island, near the mouth of the Skeena, but it would be impracticable to cross to that island with a railway line and extremely difficult to reach a point on the mainland opposite the bay.

Port Simpson, at the northern end of the Tsimpscan Peninsula, is well known, and seems to answer all the requirements for a terminal harbour.

The distance to Port Simpson is probably eight miles greater than to a point on the mainland opposite Cardena Bay, but the obstacles to the construction of a railway line are not so great, and the cost of building it would probably be less.

About 100 miles above Port Essington the Skeena Valley bends to the northward, and about 60 miles further up the Watsonquah, a large tributary, which rises near Lake François, enters it from the south. By following this valley a line can be found to the sources of the Nechaco with easy gradients and a low summit. The distance would be shortened about 70 miles if a pass could be found leading directly east, from the bend before mentioned, 100 miles above Port Essington, instead of following round the valleys of the Skeena and Watsonquah Rivers.

An exploration was made with that object, and several valleys were examined, but without success. The southernmost and only direct pass has a summit more than 6,000 feet above sea level. The more northern ones are not so high, but are still impracticable.

The only available line, therefore, from Port Simpson towards Fort George must follow the northern side of the Tsimpscan Peninsula till the valley of the Skeena is reached, ascend that valley 150 miles to the Forks, and continue up the valley of its tributary, the Watsonquah, 120 miles to the summit. Thence it should descend the

valleys of the Intaquah, Nechaco and Stewart Rivers to the line already surveyed near Fort George. The distance by this route to the summit of Yellow Head Pass, would be about 690 miles.

Engineering Features.

From Port Simpson along the southern shore of Works Canal, and across the dividing ridge—275 feet high—to the banks of the Skeena, a distance of 35 miles, the work would be expensive, being principally in rock.

For the next 40 miles the line would follow up the right or northern bank of the Skeena. The valley varies from one and a half to two miles in width, but is intersected by a net work of channels which extend to the base of the hills on either side, forming islands almost without number, and leaving no continuous flat between the base of the hills and the river. The work would be very heavy, as the mountains are lofty with steep rocky sides, which are swept by avalanches at about twelve different places. It is probable, however, that there would be little tunnelling required, the water being shallow so that rock embankments could be built round the face of bluffs where such abut on the river.

Up to the Kitsilas Canon some 40 miles farther, the valley for perhaps half the distance, continues to be of the same character cut up by channels from one side to the other, and the works would still be heavy and in rock, though the hill sides are less steep. For the remainder, there are either low flats or benches between the hills and the river where the works would be moderate.

There yet remain 30 miles before the loftier ranges of the Cascade Mountains are passed, and the works on a part of that distance would be heavy, as the rocky side hills descend to the river's bank. The larger part would be on benches, ranging from 10 to 60 feet above the river, on which the works would be moderate.

Above this point the mountains recede from the river, and for the next 35 miles the valley attains a considerable width. The benches next the river vary from 10 to 100 feet in height. The works would be moderate and in many places light.

The description has now been carried to the forks of the Skeena, about 180 miles from Port Simpson, and about 700 feet above sea level. The ascent is gradual for all that distance, and the grades would be easy, but require many undulations in order to take advantage of the most favourable ground.

The river Watsonquah, from its mouth at the Forks up to the Indian Village of Kyaghwilgate, a distance of 27 miles, is rapid, and runs most of the way through a deep ravine, which at some places assumes the character of a canon. The works would be generally heavy, but some exceedingly so with stiff gradients and sharp curves would be required occasionally.

From Kyaghwilgate upwards the valley is favourable for railway construction, and the works would be moderate with easy gradients for about 90 miles, where the line passes over the summit between the waters of the rivers Watsonquah and Intaquah, tributaries respectively of the rivers Skeena and Fraser, which is distant from Port Simpson about 300 miles, and at an estimated elevation above sea level of 2,400 feet. Thence by the valleys of the Intaquah River and Fraser Lake to the junction with the line previously surveyed from the Yellow Head Pass, in the valley of the Nechaco, the works would be moderate and grades easy.

Character of the Soil.

Round Port Simpson there is a limited area of land fit for cultivation, where the Indians have numerous potato gardens. Many of the Islands in the lower part of the Skeena are composed of rich alluvial soil, but they are usually overflowed at time of freshet. For 15 or 20 miles below the Forks and some distance above that place, the valley of the Skeena is several miles in width. The land is of fair quality and covered with a light growth of poplar, birch and spruce.

Mr. Hankin, a trader at the Forks, had a very fine crop of oats which was almost ripe on July 31st. He and others had at the same time some fine potatoes, turnips, carrots and cabbage. They had each purchased a short time previously a

small herd of cattle as an experiment, and proposed cutting hay in some of the natural meadows for their sustenance during the winter.

The slopes of the Watsonquah throughout its entire length are in part prairie, and sustain a magnificent growth of grass suitable for pasture. The roots intertwine and form a sod, which would prevent its being killed off like bunch-grass in case cattle or sheep were allowed to crop it closely.

This valley, however, is subject to frequent frosts during summer which render it unfit for agriculture.

Timber.

A tree commonly called Yellow Cypress, is found on the lower Skeena which has great strength and density of fibre and is said to be extremely durable, but the quantity is limited. The same remark would apply to hemlock and cedar, though they were seen in some places of great size.

On most of the islands subject to overflow in the lower Skeena, there is a fine growth of cottonwood which may be utilized at some future time for the same purposes to which basswood and whitewood are applied in the Province of Ontario.

Snow Fall.

The Cascade Mountains, where the Skeena breaks through them, consists of two principal ranges, which are separated by a valley extending from the Kitamat arm of Gardner's inlet in a northerly direction to the River Naas. The snow fall in the westernmost of these ranges sometimes reaches a depth of 10 feet or upwards, and the avalanches before alluded to occur there. The other range commences a little below the Kitsilas canon and extends about 30 miles above it; here the snow fall would average 6 or 7 feet. From the Forks to Fraser Lake the snow rarely exceeds 3 feet in depth.

Minerals.

Marble was seen in beds of great thickness near the mouth of the Skeena, and again about 25 miles from the coast. Some ores of copper and lead were also observed, but not in veins of any great thickness.

APPENDIX D.

REPORT BY MR. MARCUS SMITH, ACTING ENGINEER-IN-CHIEF, ON THE SURVEYS AND EXPLORATIONS WITH REFERENCE TO THE LOCATION OF THE WESTERN SECTION OF THE LINE.

CANADIAN PACIFIC RAILWAY.

OFFICE OF THE ENGINEER-IN-CHIEF,
OTTAWA, 29th March, 1878.

SIR,—I have the honour to submit a report on the results of the Surveys and Explorations made in the Central and Western regions since the date of Mr. Fleming's last report, January, 1877.

In that report, comparative estimates are given of the cost of construction of several lines, branching out of a common route, from Yellowhead Pass, in the Rocky Mountains, westward, and terminating at different points on the Pacific coast.

Of these several lines, only three are now under consideration; and in the report above referred to, they are estimated as follows, *vide* pages 62 and 63 :—

Route No. 2.

Following the North Thompson, *vid* Kamloops, to Lytton, and by the Lower Fraser to Port Moody, Burrard Inlet, 493 miles. Estimated cost of construction, \$35,000,000.

Route No. 6.

Following the Upper Fraser to Fort George, and by the Rivers Chilacoh, Nazco, and East Homatheco to Waddington Harbour, Bute Inlet, 546 miles. Estimated cost, \$33,000,000.

Route No. 8.

Vid the Upper Fraser, Fort George, Rivers Chilacoh, Blackwater and Salmon to Kamsquot Bay, De:n Inlet, 488 miles. Estimated cost, \$29,000,000.

These estimates, as stated in the Report, "include everything deemed necessary to complete the grading of the Railway, with solid embankments, iron bridges, and, generally, with durable structures equal in point of character to those on the Intercolonial line.

Also the cost of ballasting, permanent way, rolling stock, stations, shops, snow sheds and fences, indeed all the supplemental expenses indispensable to the construction and completion of a line similarly equipped and equal in efficiency and permanency to the Intercolonial Railway, and basing the calculations of cost on precisely the same data, the same value of material and the same average value of skilled and unskilled labour, as obtained on that work."

There is great probability that these estimates will prove to be too low for the class of work referred to, as the price of labour of all kinds rules much higher on the Pacific slope than on the route of the Intercolonial Railway. The cost, however, can be kept down by using stone and iron only for the larger structures, and culverts under high embankments. There is plenty of timber to be had alongside the line for constructing and renewing the lighter structures when necessary. But, as the increase of cost, if any, would be proportionate on each route, these estimates were believed to present as fair a comparison of the several routes as could be arrived at with the data then obtained.

These data, however, being imperfect, owing to the loss of plans and profiles of a portion of the route No. 2, in the fire of 1874, which destroyed the Engineers' Offices at Ottawa, it was deemed advisable to have a re-survey made, and during the past season seven parties have been engaged in that work.

A very close location survey has been made, and every effort has been employed in the endeavour to reduce the cost of construction to a minimum. By the introduction of a large number of exceptionally sharp curves a considerable quantity of tunnelling and rock excavation has been avoided; further, the line has been carried at points so close to the rivers as to require protection works against floods, while the inclination of the slopes, instead of being $1\frac{1}{2}$ to 1, as on the other routes, has been frequently increased to 1 to 1, in order to reduce the amount of excavation.

From the quantities thus obtained, an estimate of the cost of construction has been made out at the same rates for labour and materials as on the other routes. According to this estimate the comparative cost of the three lines would stand as follows:—

Route No. 2.

From Yellowhead Pass *viâ* the Rivers Thompson and Fraser to Port Moody, Burrard Inlet, 493½ miles; estimated cost, \$36,500,000. If carried to English Bay, 508 miles, \$37,100,000.

Route No. 6

From Yellowhead Pass by the Upper Fraser and the Rivers Chilacoh, Nazco and East Homathco, to Waddington Harbour, Bate Inlet, 546 miles, \$34,000,000.

Route No. 8.

From Yellowhead Pass by the Upper Frazer, and Rivers Chilacoh, Blackwater, and Salmon, to Kamsquot Bay, Dean Inlet, 488 miles, \$30,000,000.

In Mr. Fleming's estimates, an allowance was made for possible reductions in locating for construction. On information since obtained, however, a revision has been made, and the present estimates are believed to represent very fairly the comparative cost of construction on the several routes.

But, besides the cost of construction, other points bearing on the selection of the route have to be considered. The chief of these are:—

1st. The extent and quality of the lands fit for cultivation traversed or brought within easy communication with the seaboard.

2nd. Access to the mineral districts, where mining is now in successful operation.

3rd. The character and geographical position of the harbour at the terminus, and its fitness for commerce, both foreign and domestic.

These matters were discussed in a previous Report, but the enquiry was then limited to the country lying between the Yellowhead Pass and certain points on the Pacific Coast; during the past season, however, additional information has been gained, and a new route has been explored by another pass through the Rocky Mountains which diverges from the existing line at a point a little to the west of Lake Winnipegosis. Accompanying the present Report is a map shewing the several lines referred to, and coloured to shew the general character of the soil in different regions, as explained in the margin. The mileage, in former Reports, is carried on from Fort William (Lake Superior) to Yellowhead Pass, and for convenience of reference, the same arrangement is adopted here.

Southern Route (No. 2 of former Reports) via Yellowhead Pass to Port Moody, Burrard Inlet.

The line located for construction crosses the Red River at Selkirk, 410 miles from the starting point at Fort William, thence it takes a north-west course and continues in an almost direct line to Northcote—629th mile—at the north end of Duck Mountain. This is the point at which the line by the Pine River Pass would diverge. Thence the located line takes a westerly course up the valley of Swan River, to Livingstone, a few miles north of Fort Pelly.

Up to Doyle Station at the 673rd mile, the line has passed through what has been termed the fertile or wheat growing belt, shewn by buff colour on the map, stretching away to the north-west, beyond the Peace River. It now crosses a tract of soil lighter and poorer, but yet, in parts, suitable for settlement up to the 815th mile.

Between Humboldt and Battleford—815th to 961st mile—the line touches the northern limit of the Great Plains (coloured mauve) which stretch away southward to the International Boundary, and are principally prairie. The soil in parts is alkaline and saline, in others fit for the plough and for pasture, but owing to the want of wood and good water, settlement would be practicable only at intervals. Indeed, throughout the whole of this region, the surface water is bad and scarce, except in the early spring.

Between these plains and the fertile lands to the north of the Saskatchewan, there is a region of prairie, (coloured green on the map), interspersed with poplar copse, on a loamy and sandy soil, producing good crops of grass and wild pea-vine; the surface water being generally abundant. A fair proportion of this is suitable for agriculture and settlement.

The line enters this district a little to the west of Battleford, and reaches its western boundary about the 1130th mile. In this distance of 165 miles there is probably about an equal division of poor and sandy soil and of land fit for settlement. From the 1130th mile to the crossing of the River Pembina at the 1267th mile the soil is a heavy, rich loam, suitable for wheat growing, with very luxuriant vegetation, nearly identical with that of Ontario, abounding with streams and fresh water lakes, and clothed with a continuous forest of poplar and spruce. In places, the country is swampy, but it can be drained without difficulty.

At the River Pembina, rock is first seen on the surface—it is a sandstone, with coal seams underlying. Between this point and the Yellowhead Pass—1267th to 1453rd mile—the altitude is generally over 3,000 feet above sea level; the soil is cold and wet, with numerous muskegs; it is densely covered with poplar, occasional belts of spruce being interspersed with strips of Banksian pine on the gravelly ridges. This tract is unfit for settlement.

The summit of the Yellowhead Pass—altitude 3,720 feet—is the eastern boundary of British Columbia; and as this Province has formed a separate division of the surveys, a new mileage is commenced from that point to the Pacific coast.

From Yellowhead Pass to a point within a few miles of the confluence of the two branches of the Thompson at Kamloops—about 235 miles—the country is unfit for settlement. The Upper Fraser, Albretha, and Thompson Rivers flow through narrow, deep, and rock-bound valleys, with scarcely an acre of land fit for cultivation; though in some parts they are well wooded with spruce and cedar of large size. The Cariboo gold mines lie at no very great distance to the north-west of this part of the route; but a high and impassable mountain range intervenes.

At Kamloops, the line is fairly on the elevated, undulating, plateau between the Rocky and Cascade Mountains;—a belt, varying from 80 to 160 miles in breadth, and stretching from the International Boundary line, on the south, across the Province in a north-westerly direction to the watershed of the continent, between the 54th and 55th parallel of north latitude.

This belt is generally on a volcanic formation, and varies from 3,000 to 4,000 feet above the level of the sea; it has been deeply furrowed by water courses; and

the altitudes of the main valleys range from 1,000 to 2,000 feet above the sea. On the south-east portion there is little rainfall, but the soil, though dry, is rich, and produces luxuriant crops of bunch-grass, which is very nutritious, and ripens, as it stands, into natural hay. The snow in this region rarely reaches over two feet in depth, and cattle thrive on the bunch-grass during the winter, very seldom requiring any other feed.

The bunch-grass extends up to about the 53rd parallel of latitude, beyond which the rainfall increases, and blue-joint and other kindred grasses take the place of the bunch-grass.

In the bottom lands of the valleys and on the benches adjoining, the soil is very rich, producing excellent wheat and other cereals, as well as vegetables. These lands, however, are scattered throughout the plateau in isolated patches, and bear a very small proportion to the whole area. They generally require irrigation, which can only be obtained to a limited extent.

The Central, or Bute Inlet route, branches out of the one under consideration near Tête Jaune Cache; and a line drawn from this point, so as to make an equal division of territory between them, would cross the Cariboo road near the east end of Lac La Hache and the River Fraser, near the mouth of Canoe Creek.

This would give a breadth of fully sixty miles on the north side of the Southern line, and about one hundred miles on the south of it, embracing an area of about 15,000 square miles.

Notwithstanding the advantages of its position, as being on the route to the gold mines, both from the coast and from the United States, the population of this district is but small, although most of the lands available have been taken up.

By the construction of a railway to the coast a considerable impetus would, no doubt, be given to the cultivation of cereals, which, at present find a limited market at the centres of the mining industries. This is however, pre-eminently a grazing country, so that it seems probable that horses, cattle and sheep would practically continue to be, as now, the chief or only exports of the district. These, in a free grass country, transport themselves at a cheaper rate than is possible by railway.

The district is already fairly supplied with roads and good cattle trails, and in Appendix F, page 117 of the Engineer-in-Chief's Report of 1877, it is shown how the water communication can, at small cost, be rendered available, from Lake Kamloops to Okanagan.

From Savonas' Ferry, at the foot of Lake Kamloops, to Yale, the distance by the line surveyed for the railway is one hundred and twenty-three miles.

It is a few miles more by the waggon road, and it is evident that if this road were improved and developed, when required, into some inexpensive kind of railway, it would serve this district nearly as well as a line brought across the Rocky Mountains at great cost.

Spence's Bridge, on the River Thompson, is, by the located line, three hundred and twenty-seven miles from the summit of Yellowhead Pass; thence down the Rivers Thompson and Fraser, nearly to Fort Hope, a distance little short of one hundred miles, the valley is a mere gorge in the mountains, with no land, save a few garden patches, fit for cultivation, and only scant pasturage on the hill sides; the few houses on the road are only way-stations on the road to Cariboo.

Below Hope the valley begins to open up, and it becomes several miles wide, in places, before New Westminster is reached. The bottom flats are generally low and partly prairie land; the river meandering through them is occasionally divided into channels or sloughs, forming numerous islands; these are thickly clothed with cotton-wood, vine, maple, willow and other woods. There is good land on the higher benches, though but little wheat is grown in the district. The reasons for this, as given by the farmers, are:—The uncertainty of the weather during the harvest season, the alternate rains and hot sunshine causing the grain to grow in the ear before it can be housed; and, further, that they find it more profitable to raise stock, coarse grains, hay, and fruit, and import their flour than to spend money in producing wheat, which, at best, would prove to be but an inferior article. The cattle are

reared for the markets of New Westminster and Victoria; the hay and oats are sent to the logging camps, and the fruit to the upper country.

The total area of land in the valley is estimated at a little over 500,000 acres: * of this but a very small part is under cultivation, and it will require much labour and expense before any extensive increase can be obtained. The great bulk of the land that could be most easily brought under cultivation, lies on the estuary of the river below the point where the line leaves the valley for Burrard Inlet; and most of the balance is on the opposite side of the river to that on which the line is located. Much of this land is subject to overflow from the floods of the river and from high tides in the Strait.

Taken altogether, this is a very fine district, and in course of time will have a considerable population; but it is obvious that the reclamation of the low lying lands is not to be brought about by a railway, but by means of dykes, embankments, pumping machinery and such other works and appliances as have been successfully used on lands in a similar condition.

Steamboats already ply between New Westminster and Yale (90 miles) twice a week each way, and would do so daily if there were sufficient traffic. These steamers stop at any point on the river where desired for the collection of passengers or freight, however limited in number or quantity; a degree of accommodation greater than could be afforded by any railway. The amount of traffic which the valley would supply to a railway would be but limited, as its main products go seawards, and four-fifths of the traffic, both of passengers and freight, which passes up into the interior is in connection with the Cariboo Gold Mines, for the necessities of whose development there must, and will ultimately, be found a shorter and better route from some point on the coast further north. On the whole it does not appear that the prospects of a railway on this route are encouraging.

The distance from Fort William (Lake Superior) to Port Moody, at the head of the south arm of Burrard Inlet is 1,946 miles, and, if carried to English Bay, 1,961 miles.

Up to Northcote, 629 miles, the line is common to all the proposed routes westward. Between this and the Pembina River—1,267 miles—the soil is variable, and, as above described, only in part fit for settlement.

From the Pembina River across the Rocky Mountains, to a point near Kamloops—420 miles—is totally unfit for settlement. There is another length of 100 miles in the canyons of the Thompson and Fraser in a similar condition. So that from the River Pembina, on the east side of the Rocky Mountains, to the proposed terminus at Port Moody, a distance of 679 miles, there are 520 miles on which there is no land fit for settlement, and on the balance most of the land of any value is taken up; in all this distance, therefore, there will scarcely be an acre within 60 to 100 miles of the line at the disposal of the Government for railway purposes. The works, moreover, will be generally heavy and costly.

Central Line, via Yellowhead Pass, to Waddington Harbour, Bute Inlet.

This line diverges from that last described at a point thirty-eight miles west of the summit of Yellowhead Pass, and follows the Valley of the Fraser down to Grand Rapids, 181 miles from the Pass. Here the line leaves the Fraser and turns across the north end of the Cariboo Mountain Range, crossing Bear River at the 206th mile. This river rises near Barkerville, the chief town of the Gold Mining District, about eighty to eighty-five miles from the point of crossing: the valley affording facilities for the construction of a road. The line descends to the Fraser Valley on the west side of the Cariboo Range, by the Willow River, and crosses the Fraser at the 228th mile. The lower part of the Willow River Valley, for a length of fourteen

* Calculated from the map issued by the Chief Commissioner of Lands and Works.

miles, is about three-quarters of a mile wide, the soil being good both for agriculture and pasture; the elevation is 2,000 feet above the level of the sea. This is the first land of any extent fit for cultivation met with since leaving Yellowhead Pass.

The line then crosses some rough ground on the right bank of the Fraser, and reaches the Valley of the Stewart River at the 216th mile, about nine miles west of Fort George. At this point it is fairly on the elevated plateau, between the Rocky and Cascade Mountains, already described on the other route; in this district the plateau is of low altitude, ranging from 2,000 to 2,500 feet above the level of the sea. The line crosses it in a south-westerly direction by a series of valleys, rising gradually in altitude to the foot hills of the Cascade Mountains, passing through the latter by the Valley of the Homatheco, to the head of Bute Inlet; the length from Yellowhead Pass being 346 miles.

The portion of the grass region thus crossed is fully as extensive as that on the southern route, and is in part similar in character. Towards the north, however, the rain-fall is sufficient, without irrigation, and there is more woodland and soil fit for the plough.

Still, in proportion to the whole, the quantity of arable land is but small, though whatever there is, is available for railway purposes and settlement with the exception of the immediate neighbourhood of the Cariboo Mines and the approaches to them, where a population, about equal to that which would be served by the other route, is already located. It should be explained that the waggon road and the accompanying settlements, followed the course of gold discovery up the Valleys of the Rivers Fraser and Thompson to Cariboo; and as the supply of farm and other produce was obtainable in sufficient quantity from the settlements on the existing road, no farther extension has as yet been made of road or settlements northward of that district. The distance of the mines from the coast by the present road was long ago felt to be so serious an inconvenience that a waggon road from Bute Inlet to the mouth of Quesnelle was projected by the late Mr. Waddington, and 40 miles of a horse trail were actually constructed when a stop was put to the work through the massacre, by the Indians, of the men engaged in its construction. The proposed railway line follows this route generally, passing within 48 miles of Quesnelle.

On the whole, this route appears much more favourable than the other. As a colonization line it would bring a large quantity of land into cultivation, and afford much better accommodation to the gold mining district of Cariboo, where the recent developments in quartz mining give promise of a future of extraordinary prosperity.

The Northern Route, via Yellow Head Pass, to Kamsquot Bay, Dean Inlet.

This line is identical with the last, to a point in the Chilacoh Valley, 280 miles from Yellow Head Pass, where it diverges to a more westerly course, striking the Salmon River at the entrance to the Cascade Mountains, and following the same through the Mountains to Kamsquot Bay.

The length from Yellow Head Pass is 438 miles, being 58 miles shorter than the last line. This is undoubtedly the shortest practicable line across the Continent from Red River to the Pacific, and can be constructed at the least cost; it is also on the direct route to the coast of China. Both of these last two routes have, however, the same serious drawback as the southern line—the great length of sterile country in crossing the Rocky Mountains, and the considerable stretches of indifferent land which lie to the east of them. This objection was felt so strongly, that the permission of the Minister was obtained last summer to extend the projected exploration from the Skeena to Fort George, eastward, through the Pine River Pass, as far as might be possible during the season. An examination was also made of a portion of that route east of the mountains. The following are the results obtained.

Route by the Pine River Pass to Bute and Dean Inlets.

This route diverges from the located line near Northeote, at the north end of Duck Mountains, 629 miles from Fort William, Lake Superior, from which point,

following up the Valley of the Swan River about 30 miles, it would take a course as direct as might be practicable, to a selected crossing of the River Saskatchewan, near Fort à la Corne, passing on the way the head waters of Red Deer River, and the Porcupine Hills.

The land in the Valley of Swan River is reported by the Surveyors to be very rich and of considerable extent; the soil on the Baquia Hills is also reported good; while the belt between these hills and the Saskatchewan, extending from the Prince Albert settlement, above the Grand Forks, down to the Old Fort, a distance of over 90 miles, is exceedingly rich land.

From the Saskatchewan, the line would be nearly direct to the foot of the Lesser Slave Lake, skirting the north side of the Moose Hills, on the water shed of the Beaver River and passing the south end of Lac la Biche or Red Deer Lake. Low ranges of hills skirt the north bank of the Saskatchewan from a point a few miles above Fort Carleton nearly to Victoria; these are partially covered with groves of aspen and willow; the soil is generally light, but is well supplied with streams of clear water; the pasturage is good, especially in the neighbourhood of Fort Pitt.

Between these hills and the river the soil is generally sandy, and there are numerous salt or alkaline lakes; but immediately north of the hills, the soil is stated by the officers of the Hudson's Bay Company, to be very good.

There are numerous fresh water lakes, abounding in white fish; but also numerous muskegs or swamps that will require draining.

The writer drove out 16 miles north-west of Carleton, and found the character of the country gradually improving, as he had been led to expect from the description of it given by Mr. Clarke, the Chief Factor at the Fort, who has spent many years in this district. An excursion was also made from Fort Pitt to Lac la Biche. The south slope of the Moose Hills, where the trail runs, is covered with a dense grove of aspen; but in crossing the west end of these hills, a magnificent prospect opened out. Stretching away to the east, north and west, as far as the eye could reach, there appeared a vast, undulating, grassy plain, rising in places into softly rounded hills, dotted and intersected with groves and belts of aspen mixed with spruce and tamarac and clumps of willows. This appears to have been formerly forest, which has probably been destroyed by fire, decayed trunks of large trees being found on the hill sides. In the hollows, however, there is sufficient timber left for railway and domestic purposes. The altitude, taken at several points, averages about 1,700 feet above the sea level.

During three days, whenever the trail was left, great difficulty was found in forcing a way through thick masses of grass and pea-vine, three to four feet in height, and sometimes reaching nearly to the horses' backs. As Lac la Biche was neared, the country became more wooded, and the track lay through long glades between belts of poplar and willows, passing a number of small fresh water lakes.

There is a Roman Catholic Mission at Lac la Biche, where they produce excellent wheat, barley, oats and all kinds of vegetables; there are about 40 families settled round the Lake, chiefly half-breeds, engaged in the fur trade, and only cultivating enough of cereals and vegetables for their own use.

Between this point and the Lesser Slave Lake, the line crosses the River Athabaska. This country has not been explored for the railway, but from information gathered at the Hudson's Bay Post and the Mission, it appears to be rather rough and broken, with low hills and muskegs, but possessing intervals of good land.

The line would follow either the south or north shore of Lesser Slave Lake, as might be determined by the Surveys. After passing that lake, it enters on a vast region of great fertility, extending far northward on both sides of the Peace River, and westward to Pine River, which falls into the Peace near Fort St. John.

By this route, what is termed the fertile belt, or wheat-producing country, extends nearly three hundred miles farther to the west before the Rocky Mountains are reached than by the route over the Yellowhead Pass; a corresponding reduction being made in the breadth of sterile country to be crossed in the Rocky Mountain district.

In crossing the Peace River country, the line is two degrees farther north than on the parallel district traversed by the line to the Yellowhead Pass; but the climate is much milder, horses wintering out on the natural pastures.

This may be due to several causes, the chief being the difference of altitude, which is here only about one-half that on the approach to the Rocky Mountains by the other line; probably, also, the warm currents of air from the Pacific ocean produce a favourable effect. Our surveys show that the Northern Passes in the Cascade and Rocky Mountains are less than 2,500 feet above the level of the sea.

The valley of Pine River, from the Lower Forks, for 50 miles up, is one to two miles wide; the soil is good and suitable for agriculture and pasture.

This point is within 25 miles of Lake Azuzetta, near the summit, which is estimated at 2,440 feet above the sea level.

Here the valley is narrowed to half a mile, and is rather rough for about four miles on the east side. On the west side the line would follow the narrow, rocky valley of the Atunachi, about four miles, to where it joins the valley of the Misinchinea. The latter is a fine flat valley, one to two miles in breadth, thickly wooded and containing a considerable quantity of land fit for agriculture and pasture.

The line would follow down this to its confluence with the Parsnip, or south branch of Peace River, which at this point is about 800 feet wide, and 5 to 8 feet deep, with a current of $3\frac{1}{2}$ miles per hour. Crossing this and a tongue or high bench, in about eight miles the line would strike Lake Tutia, the lowest in a chain of Lakes, in the valley of the Chu-ca-ca or Crooked River, running nearly due north into the Parsnip. At Lake McLeod the line is within 50 miles of Germansen Creek, in the Ominica Gold District.

The line would follow up this valley, nearly south, for about 70 miles, to the head of Summit Lake, near the divide or watershed of the continent, which, at this point, is a swampy flat only 2,160 feet above the level of the sea; the distance being about three miles across to the Salmon River, which the line follows to a point near the Fraser, there joining the located line from the Yellow Head Pass.

The distance from the point where the two routes diverge at Northcote, by the Yellow Head Pass, to where they re-unite, is 1,081 miles.

By the Pine River route it measures a little more on the map, but there will, probably, be less curvature, and the apparent distance may possibly be reduced.

Cost of Construction.

It is difficult to form even an approximate estimate of the cost of construction without surveys, but the explorations across the Rocky Mountains show that a very great reduction can be made on the rock and earth excavations by the line through Pine River Pass as compared with the line by the Yellow Head Pass. On the Summit there will be about eight miles of heavy work; and also on the east side, in crossing valleys of various mountain streams some heavy bridging will be required; but it is not expected that any rock cuttings or tunnelling will be necessary. On the west side of the pass to the point of junction of the two lines the works will be very light, and the cost probably not more than half that on the other line, mile, for mile.

The bridging on both lines will be rather heavy in the central or prairie region and on the eastern slope of the Rocky Mountains, but the number of very large structures will be much greater on the southern than on the northern route.

We have sections of all the large rivers and valleys on the northern route, except Smoky River, which runs in a deep valley, near where it joins the Peace River, here 700 feet below the level of the surrounding country.

The valleys of the streams falling into the Peace River, however, decrease in depth towards the Rocky Mountains, and it has been ascertained that by following a valley on the east side, with an easy gradient, the Smoky River can be crossed at a low level, whilst a similar means of rising to the level of the plain on the west side will probably be found.

On the whole, the cost of the works of construction on this route may be safely estimated, so far as our examination extends, as very considerably below that on the other route.

Gradients.

The gradients on all the three routes may be considered favourable for a mountainous country, the maximum being 1 per 100 or 52.80 feet per mile, with the exception of a portion of the Bute and Dean Inlet routes, in passing through the Cascade Mountains, where the gradients vary from 60 to 110 feet per mile. But as these stiff gradients are all concentrated within a space of 30 miles on each route, the extra tractive power required for heavy loads would not be very costly, and would be compensated for in the easier gradients after the high plateau is reached; the gradients, moreover, are falling in the direction of the heavy traffic.

It is unnecessary here to analyse the gradients on each line; but on the whole it is not considered that there would be any appreciable increase in the cost of working the traffic on these two latter routes on account of the gradients. In connection with this point, it may be here stated that the Central Pacific Railroad has a continuous stretch of about 90 miles, with gradients rising 66 feet to 105 feet per mile. The Baltimore and Ohio has gradients of 115 feet per mile, which are worked without difficulty.

Harbours at the different Termini.

The selection of a harbour for the terminus of the Railway engaged much of the writer's attention during the four years he had special charge of the surveys on the Pacific Coast. Every harbour was examined with the assistance of the Admiralty charts; and from conversations on the subject with officers of the Navy and of the Hudson's Bay Company, who have navigated these waters for years, much information was gained and communicated to the Engineer-in-Chief from time to time.

From the information thus obtained, it is the strong opinion of the writer that by reason of the difficulty of access from the ocean, there is really no harbour on the coast of the mainland of British Columbia, with the exception of Port Simpson, eligibly situated for purposes of foreign commerce, and that in this respect, at any rate, they are all inferior to the American Port, known as Holmes' Harbour, at the entrance to Puget Sound, to which it is probable that more than one American railway will be extended within a few years.

On the coast of Vancouver Island, however, there are several harbours better situated for commerce with Asia than any of the American harbours.

Of the mainland harbours, Port Simpson is easily approached from the ocean, and is the nearest to the coast of Asia of any harbour in British Columbia, whilst it is fully 500 miles nearer to Yokohama than Holmes' Harbour in Puget Sound. It has also been shown that the Railway could be extended to it without much difficulty from a point in the surveyed line, west of the Rocky Mountains, to Bute Inlet; the line, however, would be 140 miles longer.--(*Vide* Report of the Minister of Public Works for 1877, Appendix, page 156.)

It should, however, be taken into consideration that the Japan current flows south-eastward, parallel with the coast; consequently, on the voyage from China, eastward, the current would be favourable, but on the outward voyage it would be the reverse. The steamers from San Francisco take the southern route out, following the bend of the current, though the distance is thereby greatly lengthened, but they return by the northern route.

Port Simpson is also too remote from the present industrial centres of the Province, and can only be looked upon as a station to which the Railway may ultimately be extended if ever the competition for the trade with China and Japan should demand it.

Kamsquot Bay, Dean Inlet, is the next harbour for consideration. It has been shewn that the line to this point is the shortest that has been found across the continent, and its construction is estimated to cost \$4,000,000 less than any other that we have surveyed; it also lies very nearly on the direct route to the coast of Japan and China. It is situated about 7 miles from the head of Dean Inlet, on the south-east side, being a bay formed by a projecting point of the shore on one side, and a spit of land, well wooded, formed by the detritus brought down by the Kamsquot or Salmon River, on the other.

It is well sheltered from every wind, and has nearly two miles of frontage convenient for the construction of wharves and slips.

At a short distance from the beach, however, the bottom slopes rapidly down into deep water, leaving but a narrow belt for anchorage. Artificial moorings would therefore, have to be provided to meet the requirements of a large fleet.

The inlet and channels leading to Millbank Sound, by which vessels would approach from the ocean, are from one to two miles wide, very deep and free from sunken rocks, affording good navigation for steamers. The distance to Millbank Sound is about 100 miles, over which sailing vessels would have to be towed. It is, however, a serious objection that there are no large bays or harbours near where sailing vessels could anchor if necessary. Several of the naval officers object to all these long inlets, on account of fogs. Our own experience has been that rain and mist drifting along the mountain sides are more prevalent in the northern inlets, and that the southern inlets, where the Straits are wider, are more subject to dead fogs. In severe winters ice sometimes forms from the head of Dean Inlet down to Kamsquot Bay, but not below it.

There is another serious objection to Kamsquot Bay as a present terminus. It cannot be reached from the settled portions of the Province, either on the mainland or Vancouver Island, without crossing Queen Charlotte Sound, which involves an exposure for a distance of 30 to 40 miles to the full swell of the Pacific Ocean, off a coast which, in a western gale, is well known as exceptionally dangerous.

This terminus, however, would be very convenient for the Queen Charlotte Islands, which are known to contain a large amount of mineral wealth, with some tracts well suited for agriculture.

Should the objections against this point as a terminus prevail, then the choice on the mainland will be limited to Waddington Harbour, Bute Inlet and Port Moody, or some other point on Burrard Inlet.

Waddington Harbour is formed by the silt and detritus brought down from the mountains by the River Homatheo on the north, and the Southgate on the east. It stretches across the head of the Inlet about two miles. The anchorage in 4 to 18 fathoms, varies from 200 yards to half a mile in breadth; outside of this the bank slopes rapidly down into very deep water. The best anchorage is at the north-east angle, where it is widest and best sheltered.

It is obvious that this is not a suitable harbour for a large fleet; it could, however, be made a good port by the construction of a pier, together with slips and wharves; there is abundance of timber and other requisite materials for such work close at hand.

Bute Inlet is about 45 miles long and two miles wide, it is completely shut in by high mountains on each side and by islands lying across its entrance, and is not exposed to gales; the channel by which it is entered is designated "Calm Channel" on the Admiralty chart.

Port Moody, at the head of the south arm of Burrard Inlet, is a snug, well sheltered harbour $2\frac{1}{2}$ miles long, and from a third to half a mile wide, with good anchorage; the hills enclosing it rise steeply from the water's edge to a height of 200 to 500 feet. There is no site for a town except a flat at the upper end, partly covered at high tide.

At Coal Harbour, just inside the first narrows, there is fair anchorage, but very limited in extent. There is a considerable area of flat land adjoining, suitable for a town site.

This arm of Burrard Inlet is about 15 miles long; the channel at the entrance is not over 200 yards wide, and the ordinary tidal current is four to eight knots an hour. In spring tides it is more rapid.

About half way up the Inlet are the second narrows, where the current is three to seven knots an hour.

English Bay, at the entrance to the Inlet is free from these inconveniences, it has a considerable extent of good anchorage, and flat land adjoining, suitable for the site of a large commercial city. This Bay, however, is exposed to gales from the west, across a stretch of at least 40 miles of open water, being only partially protected by a spit of land called Spanish Bank which is covered at high water; it would consequently require extensive works to make it a safe harbour. There are also other difficulties more or less serious. Sand-banks lie near its approach, and the neighbourhood is notoriously subject to fogs.

But the most serious difficulty of all, is one that affects alike both Bute and Burrard Inlets. The passage to the ocean by the north and south end of Vancouver Island is obstructed by a group of Islands, stretching right across the strait between Vancouver Island and the mainland.

The channels between these Islands are in places narrow and crooked, and subject to strong tidal currents, difficult of navigation, even for steamboats, and often dangerous.

A list is before me of over 60 marine disasters that have occurred in these straits within a few years.

The group of Islands commanding the channels in the southern passage are in possession of a foreign power, and the naval testimony shows that in the event of any difficulty with that power, commerce by this passage would be liable to serious interruption.

In order to conduct the railway traffic from Burrard Inlet to Esquimaux, or to any port on Vancouver Island, it will be necessary to have two transshipments, as there are 30 or 40 miles of open water to be crossed, subject to heavy gales, which would render the adoption of a steam ferry carrying a railway train impracticable.

The railway could, however, be extended nearly due south, from a point near Lake Sumas, in the valley of the Fraser, about 35 miles above New Westminster, in an almost direct line to Holmes' Harbour, which lies between Whitby and Camano Islands, at the entrance of Puget Sound. The distance is a little over 60 miles. The country is generally flat, and the railway could be constructed at less cost than from the same point to Burrard Inlet.

This is a large and excellent harbour, and it is proposed by the Americans to cut a canal from the Admiralty Inlet through a neck of land a mile and a quarter across and rising 20 feet above the level of the water, so that sailing vessels may enter from the ocean without towage, except in the short length of the canal.

The Americans are thoroughly alive to the importance of this advantage, and the adjoining lands are held at a high value. The Northern Pacific Railway will doubtless be extended to this point, as well as other projected railways.

By referring to the map and Admiralty Chart accompanying this Report, it will be seen that near Lake Sumas the line to Port Moody takes a bend north-westwards, carrying the line further away from the passage to the ocean, by the Strait of San Juan de Fuca, while the line to Holmes' Harbour leads directly to it. There can be no possible doubt that if the line comes down by the Fraser Valley route, this must inevitably be the ocean terminus. It is impossible to force commerce out of its natural channel for any length of time; it will find the most convenient route despite national boundaries.

The Canadian Pacific Railway would thus be placed in competition with the American Northern Pacific Railroad, for the commerce centring in Puget Sound; but the American citizens would be chiefly benefited. A large city would be built up by the aid of Canadian enterprise, while the main industries of British Columbia would receive no stimulus from the construction of the railway.

Extension to Vancouver Island.

The traffic of the railway could be extended from Waddington Harbour to Vancouver Island by a ferry, and ultimately by bridging, should the commerce ever become so great as to warrant the enormous expenditure. The main points in reference to this extension are so clearly stated in Mr. Fleming's Report of 1877, pages 72 and 73, that no apology is necessary for repeating his statements here.

"The connection may now be made by steam ferry, possibly accompanied by some inconvenience, and subject to occasional delays. The course of the ferry boats would be along Bute Inlet, to the south of Stuart Island, thence through the Valdez Islands to Elk Bay on Vancouver Island. The whole of this course is land, locked and smooth water. The distance is 64 miles. The chief difficulty is said to be a strong current for about two hours a day at one point: with this exception, if the railway for the present terminated at Waddington Harbour, the water to Elk Bay could be as easily navigated as an ordinary canal.

"By extending the railway along the western side of Bute Inlet, and thence across to Frederick Arm—a feasible scheme, but one exacting a heavy expenditure—Nodales Channel, a completely sheltered and an easily navigated sheet of water, is reached. This channel is reported to be free from strong currents, shoals or other difficulties, and could be used by a railway ferry at all seasons of the year. The ferry navigation between Frederick Arm on the main shore and Otter Cove on Vancouver, is about 15 miles. The length of railway line from Waddington Harbour to Frederick Arm is about 51 miles. The accompanying chart (sheet No. 2) shows the relative position of Nodales Channel, Vancouver Island and Bute Inlet."

"From Elk Bay, or Otter Cove, a railway could be carried to Esquimaux, or to a much nearer point—Alberni—at the head of the Alberni Canal; possibly to Nootka, or, perhaps, with still greater ease, to Quatsino Sound. Compared with Esquimaux the latter has the advantage of being fully 200 miles nearer the Asiatic coast. At Quatsino coal beds are reported to crop out at the water's edge."

It should be explained that the currents referred to are in the following channels, and run very strong for two or three hours each day at a certain state of the tide.

1. The Cardero channel between the mainland and the Valdez and Stewart Islands. This is in the northern passage from Bute Inlet to the ocean.

2. A cross channel, not shown on the chart, which separates the Valdez Islands. This is in a line with Bute Inlet, and would be the channel taken for the ferry from Waddington Harbour to Elk Bay on Vancouver Island.

3. The Seymour Narrows, between Valdez Islands and Vancouver Island. This does not interfere with the ferry to Elk Bay or Otter Cove, but prevents its extension southward to the better harbour of Menzies Bay.

By constructing the line down the side of Bute Inlet and across by the Estero Basin to Frederick Arm, the rapids No. 1 are avoided, and there is a clear passage thence northward to the Ocean.

The Nodales channel between Frederick Arm and Otter Cove, Vancouver Island, is about 15 miles in length, a mile wide, with deep water, and no strong currents or sunken rocks; it is well sheltered, almost straight, and could be navigated at all seasons and in all weather by a steamboat carrying a railway train. A report on the subject of this ferry has recently been made by Admiral DeHorsey.

From Otter Cove the railway could be extended to several harbours on Vancouver Island, either north or south; of these the nearest is Stamp Harbour, at the head of Alberni Canal, Barclay Sound, the distance to which is about 100 miles.

On the first 15 miles along the shore of Discovery Passage, to Menzies Bay, the country is rocky; thence down the coast to the River Qualicum—70 miles—it is flat and very favourable for railway construction. From this point the line would bend away westward, across Vancouver Island to Alberni Canal, about 15 miles, and would require some stiff gradients, but not very heavy works, except for a short distance. The line could be ultimately extended from the River Qualicum to Nanaimo and Esquimaux, the distance to the latter being about 110 miles.

The district lying between Otter Cove and Esquimault is one of the richest tracts of country in British Columbia. It comprises a considerable extent of excellent agricultural lands, overlying and adjoining vast beds of coal and iron ore. No less than five coal mines are now being successfully worked, the product ranking at San Francisco as superior to any on that coast. The iron ores from the main island and the Island of Texada have been pronounced, after assay, as of exceptionally good character, while the close neighbourhood of the coal beds offers opportunity for the establishment of iron works on an extensive scale. These advantages, added to its agricultural capabilities, sufficient for the maintenance of a considerable population, the general beauty of the country, and the salubrity of the climate of Vancouver Island, give promise of a future of great prosperity.

Esquimault and Alberni (Barclay Sound) are well known and excellent harbours, and have been already described in the Report of the Engineer in Chief for 1877, pages 308 to 311.

The Harbour of Esquimault, at the south-east end of the Island, about 60 miles from Cape Flattery, at the entrance from the ocean, is one of the finest and most convenient harbours on the coast; and with the aid of easy soundings, and the present lighting can be entered at all times. It affords excellent anchorage for ships of any size, and in no wind is the swell sufficient to create inconvenience. The Strait of San Juan de Fuca is 10 miles wide, and the Royal Roads outside the harbour afford excellent anchorage for vessels awaiting towage for ports in the Strait of Georgia.

Stamp Harbour, at the head of the Alberni Canal, is about 36 miles from Cape Beale at the entrance to Barclay Sound, on the west coast. It affords ample accommodation for vessels of any tonnage, being about two miles in length and one in width, and having a depth of from 5 to 20 fathoms.

The channel from the entrance to the Sound, is from a mile to a mile and a half wide, up to Uchucklisit Harbour, about 16 miles distant on the west side of the channel. This harbour affords good anchorage for vessels awaiting towage up the Alberni Canal, which varies from a half to three quarters of a mile in width. Sailing vessels sometimes go in with the tide, without towage, but it may be considered that, practically, the employment of tugs is necessary.

In conclusion, the writer is desirous of expressing his strong conviction, as the result of detailed investigation of the subject in all its bearings, that the line by the Pine River Pass to Bute Inlet, with extension by steam ferry to Vancouver Island, will prove the true route, whether regarded in its national or economic aspect. It traverses a far greater extent of good agricultural lands, and affords better communication with the chief gold and coal mining districts than any other route.

The fertile portion of the Peace River country, east of the Rocky Mountains, is about 400 miles in length and 300 miles in breadth.

From the reports of Professors Selwyn and Macoun, Mr. Horetzky, Hudson's Bay officials, residents at the Mission Station and others, there is no doubt but that the prospects of this rich district lie in the development of its exceptional capacity for the production of cereals. Mr. Macoun says: "As to the capability of the country for producing grain, the barley and wheat raised at 59° north latitude, took the bronze medal at the Centennial, and the size and quality of all vegetable products is astonishing." This can, undoubtedly, become the great wheat producing Province of the Dominion. In aid of its development, it possesses a noble and navigable river, which runs through its centre, affording easy means of collecting its produce, and bringing it cheaply to some convenient point, where it could be received by the railway and carried to the seaboard. The distance from a point on Peace River, near the mouth of Smoky River, to Fort William, Lake Superior, is about 1,500 miles, thence by lake and river navigation to Quebec 1,350 miles, giving a total of 2,850 miles to the Atlantic seaway. This route, however, it must be remembered, is open only six months in the year.

Westwards, to the Pacific coast, from Fort St. John on the Peace River by way of the Pine River Valley and Pass, the distances are as follows:—

To Dean Inlet, 480 miles	}	On the mainland.
To Bute Inlet, 540 miles		
To Alberni, Barclay Sound, 700 miles,	}	On Vancouver Island.
To Esquimalt, 810 miles,		

These ports are open throughout the entire year.

The question then arises, does not the Pacific seaboard, notwithstanding the greater length of ocean transit entailed, offer the best outlet for the products of the Peace River District towards the markets of Europe and Asia? In California and Oregon, immense quantities of wheat are grown yearly and exported even to England at a good profit—of wheat alone last year, San Francisco exported 4,929,690 quintals, valued at \$11,017,353.

There is no reason to doubt that the Peace River District could compete, though at some slight disadvantage in point of distance, with the wheat-growing lands of California and Oregon in trade with England, while it would be in a better position as regards the Asiatic trade.

For a distance of 300 miles from the coast, to the point where the Pine River route diverges, the line would be identical with that surveyed for the Yellow Head route. The remainder has only been explored in part; but from the information thus obtained, it may be safely assumed that though the line would probably be somewhat longer, the cost of construction would be considerably less than on the parallel portion of the route by the Yellow Head Pass.

But even were the cost of construction greater, the difference would be of minor importance in comparison with the advantages to be derived from a line of railway that would utilize the wonderfully productive powers which now lie dormant in this vast region.

Should this route meet with the favourable consideration of the Government surveys will be required from Northcote *via* the Pine River Pass to the point of junction near Fort George, but an examination of the larger river crossings and other difficult points on this route, together with the data obtained from previous surveys, would afford sufficient information to enable companies to tender for the construction and working of the whole line from Lake Superior to the Pacific, as provided for by Act of Parliament.

Meanwhile, if desirable, construction could be commenced on that Division of the line between the Pacific coast and Fort George which will not be affected by these surveys.

I have the honour to be, Sir,

Your obedient servant,

MARCUS SMITH,

Acting Engineer-in-Chief.

F. BRAUN, Esq., Secretary,
Department of Public Works,
Ottawa.

APPENDIX E.

REPORT BY MR. J. CAMBIE, ENGINEER IN CHARGE OF SURVEYS IN BRITISH COLUMBIA, ON THE ROUTE BY THE RIVERS THOMPSON AND FRASER, WITH REFERENCE TO THE COMPARATIVE ADVANTAGES OF THAT ROUTE AND THE LINE TO BUTE INLET.

SANDFORD FLEMING ESQ., C.M.G.,
Engineer-in-Chief,
Canadian Pacific Railway.

OTTAWA, April 18th, 1878.

SIR,—I have been instructed by letter of date 15th inst., from the Secretary of the Public Works Department, to report to you, on your arrival from England, my views relative to the Routes No. 2 and 6 for the Canadian Pacific Railway, leading respectively to Burrard Inlet and Bute Inlet in British Columbia.

In order that the comparison of these routes in the matters of length and cost may be more complete, I shall follow them to the Ports where they first touch the navigable tide water of the Pacific Ocean; and as those points are inadequate for the accommodation of the shipping likely to frequent them when the line has been completed, and a large through traffic developed, I have thought it well to consider to what other harbour either line may be extended hereafter in order to obtain the requisite facilities.

Route No. 2 with extension.

At the 493rd mile from Yellow Head Summit, Route No. 2 reaches tide water at Port Moody, Burrard Inlet, which is a good harbour, though small, and when traffic increases the line can, at a moderate outlay, be carried 12 miles further to Coal Harbour, which is just inside the entrance to the Inlet, or 15 miles to English Bay.

On reference to replies of naval officers to questions submitted by you for their consideration, it will be seen that Admiral Cochrane, Admiral Richards and Commander Pender recommend Burrard Inlet, with the adjacent anchorage in English Bay, as being suitable for a terminal harbour.

Route No. 6, with extensions.

At the 546th mile from Yellow Head Summit, Route No. 6 reaches tide water at Waddington Harbour, Bute Inlet.

From the statements of the naval authorities above cited, it would appear that this harbour affords an extremely limited anchorage, owing to the great depth of water; and the tortuous character of its approaches, together with the absence of anchorage along their bold rocky shores, renders the navigation of sailing vessels unsafe without the assistance of a tug. It cannot therefore be adopted as a final terminus while other harbours offering greater facilities are available, and must be used only as a temporary one, with the object of extending the line hereafter to some harbour on the outer coast of Vancouver Island; and its capability of such extension to one of those harbours is the strongest argument which can be urged in its favour.

From Waddington Harbour the line can be continued either to Stamp Harbour at the head of Alberni Canal on the west coast of Vancouver Island, a distance of

159 miles, or to Esquimalt at the southern end of the Island a distance of 249 miles, in both of which distances, a ferry of 15 miles from Frederick Arm to Otter Cove is included.

To exemplify the comparative cost of lines to the above mentioned places the following estimates are submitted;

Estimates to temporary Terminus.

On both routes, the works as far as tide water have been estimated from trial location surveys and moneyed out at rates suitable for the district.

After making allowance for possible improvements in location and for permanent way and equipment, Route No. 2 from Yellow Head Summit to Port Moody, 493 miles, will amount to \$34,000,000; and precisely similar calculations applied to Route No. 6 from Yellow Head Summit to Waddington Harbour, 546 miles, will amount to \$33,000,000.

Facilities for carrying on works.

On Route No. 2 there is good water communication in immediate proximity to the line for 100 miles from the coast, and then a waggon road for 125 miles, followed by another navigable stretch of 100 miles, thus affording easy access to it for two-thirds of its length; it may, therefore, safely be assumed that the works on this portion of the line can be carried out at a much lower rate than on the other route, which is at present devoid of any natural or artificial means of access thereto.

To bring the cost to a suitable basis for *comparison*, a deduction of at least 12 per cent should be made on the cost of all the works of this route, below formation level, thus reducing the total amount to \$31,000,000.

Extension to permanent Terminus.

To compare the cost of extending these routes to a final terminus, is a matter which cannot be attempted with any hope of approaching to accuracy, owing to the want of sufficient data,—no continuous surveys having been made,—but it is hoped that the sums named in the following estimates, will represent the difficulties to be encountered in each case, with sufficient accuracy for comparison.

In the case of Route No. 2 it will be necessary to add the cost of continuing the line to Coal Harbour, in Burrard Inlet, a distance of twelve miles say, \$700,000, or to English Bay, fifteen miles, at a cost of \$900,000.

In regard to Route No. 6, the cost of extending the line to Alberni or Esquimalt Harbours, on Vancouver Island, may be summed up as follows:—

Waddington Harbour to Alberni:—There are 51 miles of railway to be constructed along the western shore of Bute Inlet to Frederick Arm, which is known from actual survey to be excessively heavy, a ferry from Frederick Arm to Otter Cove 15 miles, requiring at least three boats with slip docks, and 93 miles of railway from Otter Cove to Alberni, thirty of which require very heavy works,—amounting in the aggregate to not less than \$14,000,000.

Waddington Harbour to Esquimalt:—The railway to Frederick Arm and ferry to Otter Cove, same as above, with 183 miles of railway from Otter Cove to Esquimalt, fifty of which are very heavy, amounting in the aggregate to about \$19,000,000.

From the foregoing it will appear that the total comparative cost of each route to a permanent terminus, is as follows:—

Route No. 2 to Coal Harbour or English Bay, say.....	\$32,000,000
“ “ 6 to Alberni, with the inconvenience of a 15	
mile ferry.....	47,000,000
Route No. 6 to Esquimalt, with the inconvenience of a	
15 miles ferry	52,000,000

The results will be brought out more forcibly, when stated in tabular form as follows:

	Distance from Summit of Yellow Head Pass to Temporary Terminus.		Comparative cost.	Distance from Summit of Yellow Head Pass to Permanent Terminus.		Comparative cost.
	At	Miles		At	Miles.	
Route No. 2...	Port Moody.....	493	31,000,000	English Bay....	508	32,000,000
Route No. 6...	Waddington Hr.	546	33,000,000	Alberni *.....	705	47,000,000
" " "...	"	"	"	Esquimalt*.....	795	52,000,000

* With the inconvenience and delay of a 15 mile ferry.

Objections to Burrard Inlet as a Terminus.

Burrard Inlet is open to a serious objection, which I have not yet touched upon, viz, that in approaching it from the sea, by the channel to the South of Vancouver Island, vessels have to pass so near to some of the Islands of the San Juan group as to "be exposed to the guns of the United States, in the event of hostilities, and that the navigation of the channel would greatly depend on the force of the United States in the locality" (See C. P. R. report of 1877, page 70) the same report then continues, "with regard to the possibility of large sea going vessels passing round the north side of Vancouver Island and reaching Burrard Inlet, all the naval authorities, with one exception, express an unfavourable opinion."

The channel at present used by vessels when passing through the Haro Strait to reach the Strait of Georgia is at several points only about two miles distant from San Juan and other Islands belonging to the United States. But in the event of war with that country, a very fair succession of channels from Active pass, across Swanson channel through Moresby passage, Sydney and Baynes Channels to the Strait of Fuca, can be had by the erection of a few beacons, and buoying out the channel where intricate and narrow; a vessel then using those channels, need not at any time approach within five statute miles of foreign territory, as will be seen in statements by Admiral Cochrane, Capt. Graham and Commander Pender.

The channel by the North of Vancouver Island could also be used by special care, and in substantiation of this fact I may state, that the steamers California 673 tons, and Otter 400 tons, have plied for a number of years, day and night, at all seasons through this passage without accident, although it is neither buoyed nor lighted. In September and October of last year H. M. S. Daring used this passage both up and down when on her exploring trip to Port Essington. In using either of the above channels to reach the Strait of Georgia, some detention would no doubt be experienced by very large vessels, owing to strong currents at certain points, which it would be advisable to pass at the most favourable stages of the tide.

** Extra cost attendant upon the adoption of Route, No. 6.*

By the adoption of the Bute Inlet route, merely to avoid the risks of delay just alluded to, and which moreover would only occur during a war with the United

States, \$15,000,000 or \$20,000,000 must be spent in the construction of 197 or 287 miles of extra railway line,—including ferry—which would cause through freight to be carried by land, an additional distance of nearly 200 miles from Alberni, in order to save 150 miles of water carriage, or in the case of Esquimalt, 300 miles by railway to save 90 miles by water.

Frederick Arm.

The possibility of Frederick Arm being found suitable for a terminal harbour, does not seem to require an extended notice. It has not been recommended by any Naval Authority, and an inspection of the chart leads to the conclusion that the anchorage is very small; that there is no roadstead within many miles of it; and that it is only suitable for slip docks for a ferry.

Gradients.

Annexed is a table of gradients from which the following conclusions may be drawn:

Of line practically level there are on Route No. 6, 48 miles less than on Route No. 2.

Of grade between .10 and .50 per 100 there are on Route No. 6, 38 miles more than on Route No. 2.

Of grade between .50 and 1 per 100 there are on Route No. 6, 42 miles more than on Route No. 2.

Of grade between 1 and 2 per 100 there are on Route No. 6, $21\frac{1}{2}$ miles, a large proportion of which is 2 per 100, and there are no corresponding gradients on Route No. 2.

It may be stated also that the grades on the Burrard Inlet route are generally short and undulating, which is not the case in regard to the other. This will be more clearly understood by reference to a diagram which has been prepared on a scale of 10 miles to the inch horizontal and 500 feet to the inch vertical.

COMPARATIVE STATEMENT of grades from summit of Yellow Head Pass to Port Moody, Route No. 2 and Waddington Harbour, Route No. 6.

Inclination.		ROUTE No. 2.		ROUTE No. 6.		Route 2 exceeds Route 6.	Route 6 exceeds Route 2.
		Miles.	Per cent of whole route.	Miles.	Per cent of whole route.		
Rising East.	Level to 10 per 100	185.65	37.60	137.17	25.10	No. of 47.92	Miles.
	Over 10 to 20 "	11.34	2.30	16.17	3	.....	4.83
	20 to 30 "	15.48	3.22	21.09	3.85	.....	5.61
	30 to 40 "	17.25	3.50	16.41	3	.....	.84
	40 to 50 "	30.26	6.14	23.62	4.33	.....	6.64
	50 to 60 "	12.95	2.63	11.77	2.15	.....	1.18
	60 to 70 "	12.43	2.53	14.81	2.70	.....	2.38
	70 to 80 "	33.20	6.74	25.49	4.70	.....	7.71
	80 to 100 "	66.06	13.42	80.32	14.70	.....	14.26
	100 to 125 "	.....	.....	5.30	.99	.....	5.30
	125 to 175 "	.....	.....	3.84	.70	.....	3.84
	175 to 200 "	.....	.....	12.37	2.27	.....	12.37
Rising West.	10 to 20 "	9.02	1.83	23.46	4.31	.....	14.44
	20 to 30 "	14.47	2.87	29.35	5.37	.....	14.88
	30 to 40 "	9.68	1.96	12.75	2.33	.....	3.07
	40 to 50 "	21.18	4.30	23.77	4.35	.....	2.59
	50 to 60 "	6.73	1.36	9.14	1.68	.....	2.31
	60 to 70 "	11.01	2.24	11.06	2.02	.....	.05
	70 to 80 "	8.55	1.73	15.92	2.91	.....	7.37
	80 to 100 "	27.74	5.63	52.19	9.54	.....	24.35
		493	100	546	100		

COMPARATIVE STATEMENT of Alignment on Routes 2 and 6, shewing lengths of different degrees of Curvature and Tangent, also the percentage each bears to entire length of line.

Alignment.	ROUTE NO. 2.		ROUTE NO. 6.		Route No. 2 exceeds No. 6.	Route No. 6 exceeds No. 2.
	Length, in miles.	Percentage of entire length.	Length, in miles.	Percentage of entire length.		
					Miles.	Miles.
Straight line.....	285.58	57.90	328.97	60.24	.....	43.28
Curves up to 1°, radius 5,730 ft.	28.83	5.85	31.94	5.85	.....	3.11
Over 1° to 2°, 5,730 to 2,865 ft.	51.92	10.53	64.36	11.79	.....	12.44
Over 2° to 3°, 2,865 to 1,910 ft.	43.82	8.89	52.69	9.66	.....	8.87
Over 3° to 4°, 1,910 to 1,433 ft.	41.92	8.50	41.17	7.54	.75	.....
Over 4° to 5°, 1,433 to 1,146 ft.	36.75	7.45	22.33	4.09	14.42	.....
Over 5° to 6°, 1,146 to 955 ft.	3.11	.63	4.54	0.83	.....	1.43
Over 6° to 7°, 955 to 819 ft.	1.25	.25	.....	.....	1.25	.....
Over 7° to 8°, 819 to 716 ft.	0.16	.....	.....	.....	0.16	.....
Total length.....	493.00	.....	546.00	.....	.....	.....
Percentage of curved line to length of respective lines...	42.10	.....	39.76	.....	.....	.....

Curvature.

From the above statement of curvature, it will be seen that there are $9\frac{1}{2}$ miles more of curved line on Route No. 6 than on Route No. 2; but of the sharper curves there is a greater length on the latter, and nearly $1\frac{1}{2}$ miles of curvature sharper than anything on Route No. 6. These, however, occur on portions of the line where the grades are easy, and so compensate for the extra resistance due to curvature; while the sharpest curves on the Bute Inlet Route occur in conjunction with the steepest gradients.

Maintenance.

The characteristics which most materially affect the cost of maintenance are length of line, grades, ferriage (if any) snow fall, and length of bridging.

Assuming the traffic to be equal to that on the Intercolonial line during the fiscal year ending June 30th, 1877, and the ordinary working expenses and renewals to be also similar to that railway, viz.: \$2,327 per mile per annum, that would cause an expenditure of \$123,000 per annum, if the line terminated at Waddington Harbour in excess of that required to Port Moody, and if the line should be extended to Alberni an expenditure including ferry of \$483,000, and if to Esquimaux \$693,000 per annum in excess of that required in maintaining a line to Coal Harbour or English Bay, and which would increase in proportion to the amount of business done, while the rates for carrying through traffic would be governed by competing lines and not by mileage carried.

TABLE showing the comparative cost of maintaining lines to certain points in accordance with the above calculations.

Distance from Yellow Head Summit.				Route No. 6 exceeds No. 2.	
Route No. 2.		Route No. 6.		In Miles.	In annual expenditure for maintenance while traffic only equals that on Intercolonial in 1877.
To	Miles.	To.	Miles.		
Port Moody.....	493	Waddington	546	53	\$123,000
English Bay.....	508	Alberni.....	705	197	483,000*
" "	508	Esquimault.....	795	287	693,000*

* Including an allowance for a 15 mile ferry.

It has been shown that there are some grades on Route No. 6 much steeper than any of those on Route No. 2, and also that there is a greater length of the heavier gradients generally, which reduce the capacity of the route and add largely to the cost of transport, thus affecting the maintenance, which would be still further increased by the extra wear and tear to the rolling stock from the same cause, but it would be extremely difficult to reduce this to a monetary value.

On the Bute Inlet route provision must be made for diverting avalanches at several points in the Cascade mountains, which would be costly, otherwise no great difficulties are likely to be encountered in regard to snow on either line, westward of Tete Jaune Cache, and eastward of that point the line is common to both routes.

The total length of bridging as estimated is $2\frac{3}{4}$ miles on route No. 6, and $3\frac{1}{4}$ miles on route No. 2, being half a mile less on the Bute Inlet route, but as the estimates have been made out for permanent structures this item need not be considered.

Local Traffic.

The resources of British Columbia are not sufficiently developed at present to furnish any considerable local traffic, though the various industries give promise of considerable extension before long.

The southern portion of the Province, which is most suited for agriculture and stock raising, would be best served by the Burrard Inlet route, while the Cariboo mining district, though about equi-distant from either line, can probably be more easily reached by the Bute Inlet route.

The former route, with a branch to Cariboo, whenever there may be trade to justify its construction, would seem to serve the interests of both sections.

I think I have in the foregoing referred to all matters specially requiring attention.

I have the honour to be, Sir,

Your obedient servant,

H. J. CAMBIE,

• Engineer-in-Charge of Surveys in British Columbia.

APPENDIX F.

CORRESPONDENCE WITH THE IMPERIAL GOVERNMENT AND OFFICERS OF THE ROYAL NAVY RESPECTING CERTAIN NAUTICAL SURVEYS AND A TERMINAL HARBOUR FOR THE CANADIAN PACIFIC RAILWAY.

The Earl of Dufferin to the Earl of Carnarvon.

GOVERNMENT HOUSE,

No. 115.

OTTAWA, 19th April, 1877.

MY LORD,—I have the honor to forward herewith to your Lordship a copy of a minute of Council, expressing a desire that the Imperial Government will undertake a survey of certain ports of the coast of British Columbia.

I have, &c.

(Signed) DUFFERIN.

The Right Honorable

The Earl of Carnarvon, &c., &c.

COPY of a Report of a Committee of the Honorable the Privy Council, approved by His Excellency the Governor General in Council on the 17th April, 1877.

On a Report, dated 16th April, 1877, from the Honorable the Minister of Public Works, stating that special efforts have been made during the past summer and autumn to procure information through the officers of the Admiralty and Royal Navy, respecting the several harbors and roadways on the coast of British Columbia, but that it would appear no surveys have yet been made of the coast adjacent to the mouth of the River Skeena, and that no decided opinion has been obtained regarding the waters in that quarter ;

That, as the Dominion Government have no means of conducting an examination in that direction, he recommends that a request be forwarded to the Imperial Government that they will direct a nautical survey to be made during the coming season, of the channels and approaches at the point indicated, and that surveys should be made of Frederic Arm, and the waters leading thereto, as decided information respecting this point should be obtained before a final decision is arrived at, fixing the seaport terminus of the Canada Pacific Railway.

The Committee concur in the foregoing recommendation, and submit the same for Your Excellency's approval.

Certified.

W. A. HIMSWORTH,

Clerk, Privy Council.

The Colonial Office to Mr. Sandford Fleming.

COLONIAL OFFICE,

DOWNING STREET, 3rd December, 1877.

SIR,—I am directed by the Earl of Carnarvon to transmit to you, for your information, a copy of a despatch received through the Admiralty, from the Commander-in-Chief on the Pacific station, together with a copy of a Report from the Commander of Her Majesty's ship "Daring" forwarding plans of the channel and approaches adjacent to the mouth of the River Skeena, prepared by him in connection with the question of the selection of a terminus for the Canadian Pacific Railway.

I am to request that the plans which are forwarded in original, may be returned to this Department.

Admiral DeHorsey's despatch has been communicated to the Governor General of Canada.

I am, Sir,

Your obedient servant,

(Signed) ROBERT G. W. HERBERT.

SANDFORD FLEMING, Esq., C.M.G.

&c., &c., &c.

(Copy)

Admiral DeHorsey to Secretary of the Admiralty.

"SHAH" AT ESQUIMALT, 9th October, 1877.

SIR,—With reference to the directions of the Lords Commissioners of the Admiralty, contained in your letter, No. 86, of the 19th May last, (received 14th August), I have the honor to report that I sent the "Daring," Commander Hanmer, to make a general examination of the channels and approaches of the River Skeena.

From Commander Hanmer's report, and from such information as I have been able to obtain, I am of opinion that, whether in view of communication with the inhabited parts of British Columbia, or of through traffic across the Pacific, the vicinity of Skeena is totally unfit for the ocean terminus of the proposed Canadian Pacific Railway. The mere circumstance that the bars of the river are not navigable for ocean steamers, except at high water, is of itself condemnatory, in my opinion. Added to this are the difficulties of tortuous approaches on a very foggy and rainy coast, and that the land in the vicinity is reported to consist of mountains and swamps, offering little inducement to settlers.

I beg to transmit herewith a copy of my orders to Commander Hanmer, and of his report, accompanied by plans of the mouth of the Skeena and of Woolcock's Landing.

The lateness of the season and the almost constant rain, caused a service of this kind (necessarily performed in open boats) to be somewhat arduous. I submit Commander Hanmer's execution of it for their Lordships' approval.

I have forwarded a copy of this report and enclosures for the information of the Governor General of Canada.

I have, &c.

(Signed) A. DEHORSEY,

Rear Admiral and Commander-in-Chief.

The Secretary of the Admiralty.

Admiral DeHorsey's orders to Commander Hanmer.

By Algernon Frederick Rous DeHorsey, Esquire, Rear-Admiral in Her Majesty's Fleet, and Commander-in-Chief of Her Majesty's Ships and Vessels employed and to be employed on the Pacific Station.

Her Majesty's ship under your command being in all respects ready, you are, on receiving instructions to part company, to put to sea and proceed to Nanaimo, there to complete with coal to your utmost stowage.

2. From Nanaimo you are to proceed to the vicinity of the River Skeena, and on your arrival you are to make a general examination of that part of the coast of British Columbia; the Governor General of Canada having requested that a survey might be made of the channels and approaches adjacent to that river, with a view to fixing a terminus of the Canadian Pacific Railway.

3. In view of the lateness of the season it will be desirable to lose no time in commencing this examination, and you are to return to Esquimalt before the severity of the winter.

4. Your proceedings are to be reported to me by every opportunity; and, as soon as practicable after your arrival off the Skeena, you are to furnish me with an estimate of the time you consider requisite for the examination ordered, specifying the part you intend to commence first.

5. On completion of the service, your report is to be furnished me in duplicate. Given on board the "Shah," at Esquimalt, this 22nd day of August, 1877.

(Signed) A. F. R. DEHORSEY.

To JOHN G. H. HANMER, Esq.,

Commander Her Majesty's Ship "Daring,"

By command of the Commander-in-Chief.

(Signed) J. H. CLEVERTON,
Secretary.

Enclosure No. 2 in Pacific Letter No. 326, of 1877.

Report of the Examination of the River Skeena by Commander Hanmer.

H.M.S. "DARING" AT DEPARTURE BAY,

4th October, 1877.

SIR,—I have the honor, in accordance with your directions, dated 22nd August, 1877, to report the result of my examination of the channels and approaches to the River Skeena, British Columbia.

1. As regards the channels and approaches of the three named respectively, Telegraph, Middle and North Channels, Telegraph Channel is available at high water for ships drawing 25 feet up to Port Essington, the deepest water being on the mainland side, abreast of Kennedy Island, and on the Island side abreast of De Horsey Island (as will be seen by the plan annexed), heavy tide rips occur at springs. The passage between Kennedy and DeHorsey Islands I have designated as the "Middle;" it is between sand banks, which, I should think are liable to shift at different seasons of the year, and is only fit for small steamers. North Channel (or North Skeena Passage), has a passage for steamers of light draught, and is entered over a flat with about three fathoms low water springs, and has an outlet between De Horsey Island and the mainland of only half a cable in width, at low water the ebb tide setting strongly through it. I do not recommend it for large vessels. Port Essington should therefore be reached from the westward, either by the Browning Entrance, Ogden Channel and Cardena Bay, or by Dixon Entrance, Chatham Sound, Arthur Channel and Cardena Bay.

2. *Anchorage*.—Skeena River has an extensive anchorage ground between Port Essington and the north end of DeHorsey Island; holding ground is good, being soft mud; at springs heavy tide rips occur, making boat or lighter work dangerous. Mr. Cunningham (a trader of many years' experience at Port Essington), informed me that the river was never frozen at Port Essington, but great quantities of ice come down in the spring, as well as immense trees. During the winter months heavy gales from the north are frequent, and, I should think, would completely suspend communication between the shore and vessels in the stream, as there is no shelter from their full force. High water approximate 1-0-0, F. & C. rise 24 feet springs.

Woodcock's Landing affords a fair anchorage, but is limited in extent (plan annexed), it is more sheltered than Port Essington, and is free from tide rips, although the ebb tide runs between four and five knots at springs; holding ground is good, being mud off the village, H. W. F. & C., 12 " 15, rise springs 24 feet approximate, neaps 17 feet (vessels must moor).

Cardena Bay is the best anchorage in the vicinity, being sheltered from N. and S.E.; holding ground is good; tide sets fairly through the anchorage; H. W. F. & C., noon springs rise 24 feet; neaps, 17 feet approximate.

The prevailing winds in the vicinity of the Skeena are said to be westerly during the summer months, and during the remainder of the year S.E. and N.E., with heavy gales occasionally from the north. Fogs are frequent in August and September. Rain is prevalent in spring and autumn, and during the stay of the "Daring," from 1st to 27th September, the prevailing winds were easterly and south-easterly, with almost constant rain and frequent squalls; during the same time the barometer's lowest was 28° 90'; highest, 30° 30'.

The land about the entrance of the Skeena is mountainous and densely wooded (chiefly cedar and hemlock) and shows signs of a remarkably wet climate, and, I should say, is quite unfit for settlement.

I have, &c.,

(Signed) JOHN G. HANMER,
Commander.

J. H. CLEVERTON,
Secretary.

(Copy.)

The Colonial Office to Mr. Sandford Fleming.

COLONIAL OFFICE, DOWNING STREET,
21st December, 1877.

SIR,—With reference to the question of the selection of a site for a terminus on the Pacific coast, for the Canadian Pacific Railway, I am directed by the Earl of Carnarvon to transmit to you for your perusal and information, a copy of a despatch received through the Admiralty from Real-Admiral DeHorsey, Naval Commander-in-Chief on the Pacific Station, reporting his views upon this subject.

I am to state that a copy of this despatch has been communicated to the Governor General of Canada for the information of the Dominion Government.

I am, Sir,

Your obedient servant,

(Signed) R. H. MEADE.

SANDFORD FLEMING, Esq., C.M.G.

Report of Admiral DeHorsey respecting Canadian Pacific Railway Terminus.

"SHAH" AT ESQUIMALT,
26th October, 1877.

SIR,—I request you will bring under the consideration of the Lords Commissioners of the Admiralty the following observations, submitting my opinion relative to the best site for the ocean terminus of the Canadian Pacific Railway.

2. With a view to forming an opinion on this subject I have carefully perused the reports of exploration of 1874 and 1877, made by Mr. Sandford Fleming, the Engineer-in-Chief, and I have had the advantage of personal interviews with Mr. Marcus Smith, Mr. Cambie, and other Engineers of the Survey. An ascent of the Fraser River, as far as Yale, and on to Boston Bar by land, has enabled me to form some idea of the difficulty of penetrating the Cascade range of mountains with a line of railway. I have further inspected Burrard Inlet, Haro and Georgia Straits (as well as the inner channels emerging at Active Pass), Discovery Passage and some of the channels in the vicinity of Valdes Island, including Seymour Narrows. An examination has also been made by their Lordships' direction of the approaches to the Skeena River, the result of which has been reported in my letter, No. 326, of the 9th instant.

3. The question of site of ocean terminus should, it appears to me, be determined by two main considerations (besides feasibility in an engineering point of view):—

1st. Its suitability for the interests and traffic of the populated parts of British Columbia, that Province having joined the Dominion upon the promise of a railway.

2nd. Its being situated at a convenient port for ocean steamers to take up, direct from wharf accommodation, the through traffic for Australia, China, Japan, and other places across the Pacific at all seasons of the year and in all weathers.

4. Bearing in mind these considerations, it appears desirable to reject all idea of a terminus on the coast between Vancouver and Queen Charlotte Islands. The navigation of that part of the coast, judging from the charts and from the reports of Admiral Richards and other naval officers, is decidedly unfavorable, and I should equally reject the vicinity of the River Skeena owing to the prevalence of fog, ice and other climatic causes incident to a high latitude, as well as to the difficulties of approach from sea.

5. If the above views are correct, the question of site for the terminus is narrowed to a choice between Burrard Inlet and a port in Vancouver Island.

6. Burrard Inlet does not appear suitable for an ocean terminus on account of difficulties of navigation to seaward. The tortuous channel from Burrard Inlet to sea through Haro Strait will frequently be unsafe on account of the strength of the tide, great prevalence of fog and absence of anchoring depth. Burrard Inlet itself also, although possessing a safe port in Coal Harbour, and a good anchorage in English Bay, has these objections, viz.: that the narrow entrance to Coal Harbour through the First Narrows is hardly safe for large steamers in consequence of the rapidity of the tide; and that English Bay, although affording good anchorage, would not, in my opinion, be smooth enough during north-westerly gales for ships to lie at wharves, there being a drift of forty miles to the north-west.

7. Another grave objection to Burrard Inlet as the final terminus, is the possession of San Juan and Stuart Islands by a foreign power. These islands form the key of the navigation inside Vancouver Island. In case of war with the United States that power might readily stop our trade through Haro Strait. (San Juan was visited last month by General Sherman, I believe with a view to its fortification.)

8. Condemning Burrard Inlet for the above reasons, I conclude that the terminus should be in Vancouver Island, which may be reached in three ways:—

1st. By steam ferry carrying a train from Burrard Inlet to Nanaimo.

2nd. By bridging Seymour Narrows.

3rd. By steam ferry, carrying a train from Estero Basin (Frederick Arm) to Otter Cove.

9. The train once landed on Vancouver Island, can, I understand, be carried without much difficulty either to Esquimalt or to Quatsino Sound, or perhaps to Barclay Sound, where Uchucklesit Harbour forms an admirable port.

10. The first method of crossing the Strait, that of a steam ferry from Burrard Inlet to Nanaimo, has three objections,—1st. The drawbacks above mentioned to navigating the First Narrows, and to going alongside a wharf in English Bay; 2nd. The difficulty and certain frequent detention in mid-channel, owing to fog; 3rd. The heavy sea with north-westerly and south-easterly gales, which would be at least inconvenient for the conveyance of a train across the Strait of Georgia. Another, and I think a cardinal objection, to the route by the course of the Fraser River and Burrard Inlet, is its passing within six or eight miles of United States territory, and its consequent liability to destruction when most wanted in time of war.

11. The second method that, of a line of railway across Valdes Island without water conveyance would require very expensive bridging. Valdes is not one island as shown on the Admiralty Chart, but consists of three or four islands.

The main difficulty, of course, exists in bridging Seymour Narrows, a distance of 2,575 feet, in two spans of respectively 1,200 and 1,350 feet. To execute this work the middle pier has to be erected on a rock, said to be eighteen feet under water at low tide, with a velocity of tide over it of from five to eight knots. This would be a work of vast magnitude and expense, even if it be practicable to place a foundation on the rock, which I doubt, as there is hardly any slack tide. Nor must it be forgotten that bridging Seymour Narrows would, as regards large ships, obstruct the only practicable channel between Vancouver Island and the Main. This alone should, in my opinion, preclude its attempt.

12. The third method, and the one I recommend, that of ferrying a train from Estero Basin to Otter Cove, is, in my opinion, not only feasible, but perfectly simple. I have carefully examined this route, and find:—

1st. That Otter Cove is well adapted for a pile dock terminus for the steam ferry.

2nd. That the head of Frederick Arm, at the entrance to Estero Basin, is also well adapted for a pile dock terminus.

3rd. That the channel between the two is easy of navigation, being nearly straight, free from dangers, smooth as glass, sheltered from all winds, and having very little tidal stream.

13. The tide in this, the Nodales Channel, is noted on the chart as running from two to three knots, but I think it is much less.

I spent five hours in this channel during what should have been the strength of the tide, the day before the full moon, and found the tide scarcely perceptible.

The distance for steam ferry between the two ports is thirteen miles of still, clear navigation, and I consider it may, with proper signals, be safely traversed in a fog.

14. In advocating the route by Frederick Arm, it will be observed that I am assuming that the railway can be brought to that point.

This assumption is borne out by Mr. Fleming's report of 1877, in which he states it to be "a feasible scheme," but one exacting a heavy expenditure, which expenditure would, I suppose, be in part compensated by the route No. 6, from Yellow Head Pass to the head of Bute Inlet, being estimated at two million dollars less than that by the Lower Fraser (No. 2) to Burrard Inlet.

15. From conversation with Mr. Marcus Smith (the principal officer of the survey, next to the Engineer-in-Chief) I am given to understand that the Rocky Mountains can be crossed at a comparatively low level, and that the line can be carried through a far less mountainous district by avoiding Yellow Head Pass altogether, and selecting a route by Lesser Slave Lake and Pine River Pass, and thence in a more or less direct line to Bute Inlet. Should this prove correct, it will be an additional reason for ending the main land route at Frederick Arm rather than at Burrard Inlet, omitting, as I do, all consideration of taking water conveyance from the head of Bute Inlet on account of its length and tortuous passages, which would be impracticable in foggy weather.

16. Having thus come to the conclusion that the line should pass by Frederick Arm, and that the train should be conveyed by steam ferry through Nodales Channel, to Otter Cove, the extension to one of the good ports of Vancouver Island remains to be considered.

17. In future years, I imagine that for the sake of more direct through ocean traffic, a line will be extended to Quatsino Sound, by bridging Quatsino Narrows, and thence on to a terminus at Winter Harbour.

18. But for present wants, it seems that the line should be continued from Otter Cove past Bayne's Sound and Nanaimo to Esquimalt, there to make the ocean terminus. This port is easy and safe of approach at all times; its dock (to take the largest ships) has been commenced, and there is reason to think that the line coming from the principal collieries and iron districts on Vancouver Island, ought to pay itself in great part by the conveyance of minerals to Esquimalt for shipment. Not only for trade, but for the supply of coal to Her Majesty's Squadron at Esquimalt, a line of rail from Nanaimo would be advantageous, as the possession of San Juan might enable the United States, in case of war, to cut off our supply from the mines by sea.

19. Assuming, therefore, that a line of rail between Esquimalt and Nanaimo will be constructed, not only for the reasons above detailed, but because its construction appears to have been virtually promised by the Dominion Government in accordance with Lord Carnarvon's suggestion (a large portion of the rails are actually lying at Esquimalt), the chief difficulty connected with the Vancouver part of the through line will be overcome, for I understand that the extension of the line from Nanaimo to Otter Cove presents comparatively few difficulties.

20. It will be observed that I have omitted consideration of a terminus in Howe Sound. This is because the same objections in respect to difficulties of navigation to sea through Haro Strait, apply to Howe Sound as to Burrard Inlet, and with greater force. The route to Howe Sound is also, I observe, estimated to cost six million dollars more than that to Bute Inlet.

21. Finally, whilst submitting the foregoing remarks in accordance with their Lordship's instructions to me, of the 23rd August, 1876, I beg to express much diffidence in respect to such as are not strictly within the scope of the Naval Service. Viewing the shortness of my stay in British Columbia waters, this Report cannot pretend to deserve much weight; but it has, I submit, one merit, that of coming from an officer who, from his position, must be totally disconnected from all local interests.

I have, &c.,

(Signed)

A. DE HORSEY

Rear Admiral and Commander-in-Chief.

The Secretary

To the Admiralty.

(Copy)

Mr. Sandford Fleming to the Hon. A. Mackenzie.

CANADA BUILDINGS, 31 QUEEN VICTORIA STREET,

LONDON, E.C., 26th December, 1877.

DEAR SIR,—I have received copies of Admiral DeHorsey's despatches of the 9th and 26th October, respecting a terminus for the railway in British Columbia, the originals of which have been forwarded to Ottawa.

Admiral DeHorsey gives expression to very decided views: amongst other things he recommends the rejection of all idea of a Northern terminus. In acting on this recommendation, the Government should, I think, have something more, if possible, than an opinion, however strongly expressed. I think it should be in possession of all the information which exists; indeed it would be desirable to have on record data sufficient to enable any one to judge of the propriety of completely rejecting a northern terminus from consideration, before that course is finally adopted.

I have considered it my duty, therefore, to address a communication to the Colonial office (of this date) a copy of which I herewith enclose.

I am, dear Sir,

Yours very truly,

(Signed) SANDFORD FLEMING.

The Hon. A. MACKENZIE,
Minister of Public Works,
Ottawa.

Mr. Sandford Fleming to the Colonial Office.

CANADIAN AGENCY, 31 QUEEN VICTORIA STREET, E.C.

LONDON, 26th December, 1877.

SIR,—I beg to acknowledge the receipts of Admiral De Horsey's despatches of dates 9th and 26th October, on the subject of a site for a terminus on the Pacific Coast for the Canadian Pacific Railway, both despatches having by the direction of the Earl of Carnarvon been recently transmitted to me for perusal.

As requested by you, I now return the plans of the mouth of the River Skeena, which accompanied Admiral De Horsey's despatch of the 9th October.

I have carefully read these important documents, and I find that the River Skeena is objected to on account of difficulties of approach from sea and climatic causes incidental to a high latitude. In considering these objections, I have thought it possible that the Canadian Government, before completely rejecting all idea of a northern terminus, may desire to obtain some further information. I deem it my duty, therefore, in order that delays may be avoided, to suggest that the following enquiries be made:—

1. If the nautical examination instituted by the Admiralty, have been extended to Metlah Catlah, Port Simpson, or other points on the coast, beyond the immediate mouth of the River Skeena, with the view of ascertaining how far any of them may be eligible for the purpose of a terminus.

2. If the Admiralty is in possession of data respecting the prevalence of rains, winds, fogs, &c. on the coast referred to, which would admit of a comparison being made between it and well-known places in nearly corresponding latitude on the coast of Europe or elsewhere. Take for example the coast of British Columbia, between latitudes 54 and 55, embracing Dixon Entrance, Portland Inlet and River Skeena, as compared with the coast of Great Britain, between latitudes 55 and 56, embracing the north channel and the Frith and River Clyde.

I have, &c.,

(Signed) SANDFORD FLEMING.

ROBERT G. W. HERBERT, Esq.,
Colonial Office.

(Copy.)

The Colonial Office to Mr. Sandford Fleming.

COLONIAL OFFICE, DOWNING STREET,

3rd January, 1878.

SIR,—I am directed by the Earl of Carnarvon to acknowledge the receipt of your letter of the 26th December, making certain enquiries in connection with a report recently furnished by Rear Admiral de Horsey, respecting a site for the terminus of the Canadian Pacific Railway.

Lord Carnarvon desires me to inform you that he has forwarded a copy of your letter to the Board of Admiralty, with a request to be supplied with an answer on the points which you have raised.

I am, Sir,

Your obedient servant,

(Signed) R. H. MEADE.

SANDFORD FLEMING, Esq., C.M.G.

(Copy.)

The Colonial Office to Mr. Sandford Fleming.

COLONIAL OFFICE,

DOWNING STREET, 9th February, 1878.

SIR,—With reference to your letter of the 26th of December last, asking that certain information may be obtained from the Board of Admiralty, in regard to the coast of British Columbia, beyond the immediate neighborhood of the mouth of the Skeena River. I am directed by the Secretary of State for the Colonies to transmit to you, for your information, a copy of a letter from the Board of the Admiralty, with the charts which accompanied it.

Should you wish the Hudson Bay Company to be consulted in regard to the climate on the portion of the coast referred to, as suggested by the Admiralty, Sir Michael Hicks Beach will be happy to give the necessary directions for this purpose, although the Company would no doubt give you any information in their power on a direct application from yourself.

I am, Sir

Your obedient servant,

(Signed) ROBT. G. W. HERBERT.

SANDFORD FLEMING, Esq., C.M.G.

(Copy.)

The Board of Admiralty to the Colonial Office.

ADMIRALTY, 10th January, 1878.

SIR—With reference to your letter of the 3rd inst., forwarding copy of communication from Mr. Fleming, the Chief Engineer of the Pacific Railway, in which he requests to be supplied with any information which this Department may have in its possession relative to the nature of the coast of British Columbia, beyond the immediate mouth of the River Skeena, and as to the meteorology of those parts, I am

commanded by my Lord's Commissioners of the Admiralty to acquaint you, for the information of the Earl of Carnarvon, that the coast and inlets from the Skeena River, northward to the boundary of British Columbia, were charted by Admiralty surveyors in the years 1867-8 and 9, to meet the requirements of navigation; but these surveys took place before the question of a railway terminus had arisen, and their results are published in the accompanying charts Nos. 1,923 a, 364, 2,426, 2,431 and 2,190.

2. In this extent of coast there is not, in the judgment of Staff Commander Pender, who was in charge of these surveys, a suitable site for a terminus.

3. A meteorological journal was kept during the progress of the Admiralty survey (1867-8-9) which is in manuscript at the Hydrographical Department of this office, and may be consulted or copies taken by Mr. Fleming.

4. I am further to inform you that the Hudsons' Bay Company could probably give some statistics of weather, etc. from their long established trading post at Fort Simpson. The mission stations at Metlah Catlah and Kincolith could also possibly supply information on these points.

I am, etc.,

(Signed) ROBT. HALL.

The Under Secretary of State,
Colonial Office.

APPENDIX G.

REPORT ON AN EXPLORATION OF PINE RIVER PASS BY MR. JOSEPH HUNTER.

CANADIAN PACIFIC RAILWAY OFFICE,

VICTORIA, B.C., 19th January, 1878.

SIR,—I beg to submit the following report on my explorations in British Columbia during the past season in connection with the survey of the Canadian Pacific Railway.

My duties, as set forth in your instructions of May last, were to obtain a general knowledge of the country north of the great bend of the Fraser River and east of the Telegraph Trail, in continuation of previous northern explorations, and in connection with a proposed examination of the route by the River Skeena; to seek for a pass through the Rocky Mountains by way of Pine River; and, if such existed, to determine its position and character, as well as examine its approaches from east and west. It was suggested that I should travel by the Telegraph Trail from Quesnelle to Stony Creek, thence to McLeod's Lake by way of Fort St. James, and then eastward to the Rocky Mountains, returning to Giscome Portage by a route as far south as practicable, and along the Fraser to Quesnelle.

This programme, although apparently simple enough, was sufficient to occupy me during nearly the whole of the open season.

Business relating to another Department detained me in Victoria till the 22nd of June, on which day I left for the Upper Country, arriving at Quesnelle on the 29th. I here found a pack-train waiting, numbering thirty animals, with the necessary equipment and supplies for the season. Ten of these with their loads were to be sent to the Forks of Skeena for service in connection with the proposed exploration of that river; the remaining twenty to be used by myself and party as circumstances might direct.

The pack-train left Quesnelle by the Telegraph Trail on the morning of the 30th June. On Monday, July 2nd, I followed, and the same day overtook the train at Blackwater River, 43 miles from Quesnelle.

Sinkut Lake was reached on the forenoon of the 6th July, and as the trail by which we intended to travel eastward diverged from the main trail near this point, we camped here, and occupied the remainder of the day in selecting the animals and stores which were to be sent to Skeena Forks. These were despatched to their destination on the morning of the 7th, and the same day our train made the Nechaco River Ferry.

In the meantime, I rode round by the upper crossing of Stony Creek to where the line of Division "S," 1876, crosses the Telegraph Trail at Station 3220-50, Lat. 53° 55' N., Lon. 124° 8' W. Altitude above the sea, 2,403 feet. This I took as the initial point of the season's operations, and commenced a track survey along the trail towards Fort St. James.

From the starting point the trail runs along the left or north bank of Stony Creek for $2\frac{3}{4}$ miles, when it crosses at a fishing weir to the right bank, and follows a north-easterly course for two miles, leaving the Creek to the left. It then turns north-westerly, and re-crossing Stony Creek at a swampy ford, reaches the Nechaco Ferry at $7\frac{1}{4}$ miles.

The Nechaco River is here about 525 feet wide, maximum depth of water ten feet; current running five miles an hour over a sound gravel bottom. A small island lies in mid-channel a little below the ferry, and for some distance along the right bank above and below this point the land is of good quality and pasture abundant.

The stores, rigging and animals were crossed on the evening of the 7th, and we started forward early next morning.

The trail, on leaving the river, ascends at once about 150 feet to a fine grassy plateau of rich soil, suitable for profitable cultivation. At $4\frac{1}{2}$ miles from the river, the northern edge of this plateau is reached, and the trail begins to ascend in a northerly direction, the dividing ridge between the Rivers Nechaco and Stewart. The summit is crossed at an altitude of 720 feet above the Nechaco, distant therefrom about $10\frac{1}{2}$ miles. The descent to the Stewart River of 840 feet is made in $5\frac{1}{4}$ miles. On the last mile the fall is 470 feet, but the trail in this locality seems to have been carried over ground considerably above the average level of the surrounding country.

Stewart River runs on a soft muddy bed with a sluggish current, and at the ferry is about 600 feet wide. The river valley at this point is a little over half a mile in width.

From the ferry, the trail turns up stream and winds along the left bank 10 to 25 feet above water-level for three miles, when it begins to diverge from the river to the right, and, ascending by three benches, gains at the fourth mile from the crossing a sandy plateau, 240 feet above the level of the river. After following this plateau, at nearly the same altitude, for three miles, the trail descends 70 feet into the valley of Nine Mile Creek, which it crosses. It follows down the right bank of this creek, through some rich grass and good land, for seven and a half miles, when it leaves the creek and ascends to the east, passing the base of a rocky slide from which Stewart's Lake can be seen. The trail then runs along a hard rocky ridge for a short distance, when, descending into the low plain, nearly on the level of Stewart's Lake, it runs N. 53° W. till reaching that lake at Fort St. James, a trading post of the Hudson Bay Company, $46\frac{3}{4}$ miles from the starting-point at Stony Creek. We arrived here on the evening of 10th July.

Leaving Fort St. James on the 11th, our route lay for five miles N. 70° E. through a narrow belt of fine grassy country, 170 feet above the level of Stewart's Lake, or 2,400 feet above the level of the sea.

At the 57th mile a small stream about three feet wide is crossed. Here Sir Geo. Simpson, Governor of the Hudson's Bay Company, camped in 1828, when travelling from Fort McLeod to Fort St. James. The stream, from this circumstance, has been dignified by the name of "Governor's River."

Carrier Lake is reached at the 64th mile from Stony Creek. The trail skirts the south shore of this lake for two and a quarter miles, and passes to the north of Round Lake and Deadman's Lake, over some high gravelly knolls and ridges, reaching Salmon or Canoe River at $73\frac{1}{2}$ miles, but the trail turns to the left and crosses this river by a shallow ford two and a half miles further up stream. We camped here on the 13th, on a bench 110 feet above the level of the river.

On the 14th July our march was from Salmon River to Swamp River, a distance of $10\frac{1}{2}$ miles N. 20° E., over a poor, sandy, burnt country. The trail between these points crosses White Mud River three times. This is a small, sluggish stream, 10 to 30 feet wide, bordered in many places by grass and spruce swamps, and running in a narrow valley 150 to 200 feet below the general level of the plateau.

Swamp River is an insignificant sluggish stream, twenty feet wide. Its valley, a quarter of a mile wide is soft and swampy. The ground on each side rises by gravelly benches to the plateau which is here about 100 feet above the river.

From Swamp River to Carp Lake crossing a distance of eight and three-quarter miles, the trail runs on a general bearing of N 56° E. The soil for this distance is of a sandy nature, and the surface of the country comparatively level. The watershed between the Pacific and Arctic Oceans, occurs at the 90th mile, or four and a half miles to the east of Swamp River, altitude 2,620 feet above the sea. Carp Lake crossing is about 120 feet wide, and for 60 feet of this distance, mules have to swim. The ground on each side is hard and firm. This crossing saves a long detour round the west arm of the lake. The lake itself is about six miles long north-east and south-west, and from two to three miles wide. Its shore line along the east and

south sides is very irregular, and, with the exception of narrow flats along the shore, the surrounding country is broken up into gravelly and rocky ridges.

Carp Lake drains into Long Lake by a crooked river forty to sixty feet wide. This river is crossed at the 106th mile at a shallow ford near the outlet of Long Lake. One mile below this crossing occurs a nearly perpendicular fall on the river of 130 feet.

From the crossing of Long Lake River to within seven miles of Fort McLeod, the trail passes through a high rough broken country, in many places much encumbered by fallen timber. Iroquois Creek, running in a deep narrow valley, is crossed at 108½ miles. From the 112th to the 114th mile, the country falls 340 feet, to a sandy plateau 75 feet above the level of McLeod's Lake. Along this plateau, the trail runs on a bearing of N 28° E for five and a half miles, when it descends from the plateau, and crosses Long Lake River near its outlet, into McLeod's Lake, and a quarter of a mile from Fort McLeod, which is reached at 119½ miles from the initial point. The party arrived here on the 16th of July, 17 days from Quesnelle.

The general character of the country through which the trail passes from Stony Creek to Fort McLeod, is identical with that of the country for a considerable distance to the southward. It is intersected by the three main rivers, Nechaco, Stewart or Nacosa, and Salmon or Canoe, running in a south-easterly direction. These rivers derive their chief, and almost only sources of supply from the great lake area, stretching easterly from the eastern base of the coast range to the Arctic watershed, and southerly from Lake Tatla in latitude 55° 30' N. to Lake Gatcho, a distance of 175 miles.

The country in the neighbourhood of the route traversed, contributes but little to swell the volume of the rivers above named. There are no lateral streams of any importance, and consequently no lateral valleys sufficiently well marked to guide the course or regulate the grades of a railway, and, although the land does not rise to any great altitude, the location of a line would not be free from difficulty.

Throughout nearly the whole extent, but more particularly from Fort St. James to McLeod's Lake, the country is broken up by narrow sandy and gravelly ridges, and rounded hills rising from 200 to 500 feet above the general level, low boggy flats and depressions containing stagnant pools, and small lakes, and small sluggish streams running in all directions.

Between the Nechaco River and the valley of McLeod's Lake, three watersheds or summits are crossed, the particulars of which are shown in the following table:—

From	Altitude above Sea.	Eastward to	Altitude above Sea.	Distance.	Rise or Fall.	Per Mile.
	Feet.		Feet.	Miles.		Feet.
Nechaco River.....	2,270	Summit.....	2,990	18	Rise, 720 feet.....	40
Summit.....	2,990	Stewart River.....	2,150	5½	Fall, 840 do.....	168
Stewart River.....	2,150	Summit.....	2,790	4½	Rise, 640 do.....	144
Summit.....	2,790	Salmon River.....	2,530	7	Fall, 260 do.....	37½
Salmon River.....	2,530	Summit.....	2,800	6½	Rise, 270 do.....	40
Summit.....	2,800	McLeod's Lake.....	1,890	38½	Fall, 910 do.....	23 8

No difficulties of a more than ordinary character would be met with in crossing the above rivers.

In projecting a line of railway through the country above referred to (that is from Stony Creek to Fort McLeod), detailed and careful explorations would, no doubt, obviate some of the difficulties now apparent. It may, however, be stated with safety, that the alignment and grades would in any case be objectionable and the quantities excessive.

The timber on this tract of country is generally of an inferior quality. The higher portions of the land are covered with the common black pine. Occasional patches of good spruce are met with, and a few Douglas firs were noticed on the shore of Round Lake, near the 67th mile. The lake shores are generally bordered by alder and birch. Balsam seems to flourish, and attains to considerable size in the neighborhood of Fort McLeod. A large area of the country has been desolated by fire.

The journey from Quesnelle to McLeod's Lake was over a route long established and well known, and we found few obstacles in the way of rapid travel. Eastward of McLeod's Lake, however, the country was known only as an Indian hunting ground, and the information regarding it was both scanty and unreliable.

On the way out I made every endeavor to obtain some information in respect to the locality of the northern passes through the Rocky Mountains, and more particularly in regard to the pass by way of Pine River. In this I was not very successful. Nearly all the Indians had left for the mountains on their annual hunting expeditions two weeks before my arrival, and I could find no one with anything like a reliable knowledge of the Pine River Pass, nor could I get any positive assurance that such a pass existed at all.

At Fort McLeod was an old Kootenian who, in her young days, had been acquainted with the country in the neighborhood of the Rocky Mountains. This lady, with a sharpened stick, drew a rough map on the sand, and explained it to the best of her ability. By the aid of broken English, Patois and Chinook, I was given to understand that there were two streams, the Misinchinea and the Mischinsinlicia, tributaries of the Parsnip River, by either of which I could reach a pass through the Rocky Mountains. The former was the stream visited by the geological party in the summer of 1875.

By following the Misinchinea it was said I would find at its source a lake shedding its waters east and west, and which formed the source of a river falling into the "Great River," near a "Hudson Bay House."

The route by the Mischinsinlicia, the smaller stream, seemed the less satisfactory, and all my efforts failed to elicit from my informant any idea of the comparative altitudes at the sources of the rivers above named.

Having resolved to try the pass by the Misinchinea, arrangements were made for the trip, and we left Fort McLeod on the 18th of July, the party now consisting of eight persons in all, including three Indians, whom I hired with great difficulty by the way.

The stores were sent by water down Pack River and up the Parsnip, to meet the train at the mouth of the Misinchinea, about ten miles north easterly from Fort McLeod. This enabled the pack train to move more rapidly over the rough and swampy country bordering Pack River.

We travelled down the left bank of this river for three miles, then crossed to the right or east bank, reaching Tutia Lake in four miles, on the shore of which we camped. On the 19th we cut our way through the timber on the ridge between the Pack and Parsnip Rivers.

This ridge, where crossed by the trail at the summit, is about 250 feet above Tutia Lake. The ground rises rapidly from the lake, and after attaining the above altitude runs out nearly level to the Parsnip River. A steep gravel bank fronts the river on the west side, where the trail approaches it. Half a mile lower down the banks on each side are about the same altitude, or 30 feet above the river.

A good crossing of the Parsnip could be effected here. The width would be about 800 feet; height of piers, 35 feet; depth of water, 5 to 8 feet; bottom, gravel; current, $3\frac{1}{2}$ miles per hour. To reach this crossing the line would have to bend northward by an arm of Tutia Lake, which opens up the ridge or plateau and affords the means of crossing it at a lower level.

On the morning of the 20th we left the Parsnip River and journeyed up the Misinchinea, keeping the left or south bank where the travelling was good, and where could be seen faint traces of an Indian trail, which, however, soon ended at an old trapping camp, and we saw no more of it.

Our first camp on the Misinchinea (No. 20) was on a fine wide bench about 200 feet above the level of the river. This bench extends about six miles up the valley, and lies mostly on the left or east bank.

From camp No. 20 the general upward course of the valley for eleven miles is N. 25° E. The rise on this distance is very small, the current on the river being hardly perceptible.

The valley at its entrance, and for some distance upwards, is enclosed by hills, rising gently on each side, and in some instances green to their tops. Farther in, however, the mountains assume a more bold and rugged character, with steep and rough rocky slopes. The open sandy benches give place to low swampy flats, and the river is hemmed in by dense thickets of alder and willow.

The difficulties of travel had now materially increased, several unsuccessful attempts were made to carry the trail high up on the mountains, and for six days we cut our way foot by foot through the dense jungle with which the valley at some points is covered throughout its entire width.

Although presenting many obstacles to travel, the whole of this low land is susceptible of reclamation by drainage, and seems generally well suited for agriculture.

On the 1st August we had reached a point thirty-one miles from Fort McLeod, where the Misinchinea valley begins to rise rapidly, and the river shows innumerable bars of sand and pebbles with many shallow rapids and drift piles.

Following up the valley from camp No. 29, we came in three-quarters of a mile to the "Atunatche," a stream fifteen feet wide, falling into the river from the northward. Beyond this a short distance the Misinchinea issues from a narrow gorge or canyon, walled in by bluffs of rock and gravel.

In front and running in a north-west and south-east direction is a range of high bare, rounded, limestone mountains. This range forms a barrier on the east side of the Misinchinea valley, which turns sharply to the southward, near the mouth of the Atunatche.

For five miles after passing this tributary, travelling at a low level being impossible, the trail was carried along the west side, 500 feet above the level of the river, on a well timbered bench, from which we found the descent to our camp, No. 30, of 2nd August, extremely difficult. This camp is 2,630 feet above sea level, the rise in the last five miles being 380 feet.

From the elevated points on our route, during the next four days, we looked anxiously for some lateral opening by which, at a practicable altitude, we might cross the range on our left. The upward bearing of the valley was now a little West of South, it was rapidly rising, and the distant mountains, wherever a glimpse could be caught of them through the thick woods, seemed high and rough and well patched with snow.

On the 7th August we had reached an altitude of 3,000 feet above the sea. The valley had expanded into a wide swampy flat, while the volume of the river had materially decreased, and it was evident we were rapidly approaching its source.

Selecting one of the mountains on the left as being about the average altitude of the range, I commenced its ascent at noon of the 7th, and had climbed but a few hundred feet, when I saw that, as far the Misinchinea was concerned, our exploration was at an end; for we were within a few miles of where the valley branched out on every side into rocky ravines, raising abruptly into the mountains.

The last 500 feet of the ascent was made over loose limestone slide, on which travelling was both difficult and precarious; and at an altitude of 5,550 feet above the sea I reached the summit. The view on all sides was uninterrupted.

North-easterly from where I stood, and about 500 feet lower, was a small round lake, one-quarter mile in diameter, shedding its waters eastward down a dark, crooked, rock-bound valley. Looking farther to the eastward, the view was over a rugged, rocky, mountainous country; S. 40° E., in the direction of the Fraser River, very high mountains, all tipped with snow, stretched away to the limits of the horizon. With the exception of the rough peaks enclosing the valley of the Misinchinea, a low wooden country lay to the westward. To the north the country

generally seemed falling; and I could clearly trace the valley of the Atunatche, along the base of the main range from the southern bend of the Misinchinea, and nearly in a line with the valley of that river. Yet the prospect in this direction was not encouraging; for the view through what afterwards proved a feasible pass, was obstructed by the overlapping profile of the opposite mountains.

We seemed to be in the heart of the Rockies, and it was evident that no pass need be looked for to the southward; so I resolved to turn northward, and, retracing our march to the mouth of the Atunatche, follow up the valley of that stream, in the hope of being able to pass eastward round the northern limit of the higher mountains.

Having, with the point of my bowie-knife, inscribed my name and purpose on a smooth block of limestone, I descended the mountain, and came up with the party a short distance ahead of where I left them. On observing the peculiar character of the surroundings, and being hemmed in on every side by wind-fall, they had camped early to wait for further orders. The barometer at this camp (No. 34) indicated an altitude of 3,010 feet above sea, the distance from the Atunatche being 26 miles.

On the morning of the 8th August we turned back, and reached the mouth of the Atunatche (altitude 2,150 feet) on the 10th; and the next day we pushed on up the valley of that stream on a bearing of N. 12° E. The travelling was difficult; the stream runs in a narrow gorge, and the ground on either side is much broken up into rocky and gravelly ridges, the general surface rising slowly to the mountains on either side.

At three and three-quarter miles we reached the south end of Azuzetta Lake. The rise in this distance is 270 feet; the altitude of the lake, which drains into the Misinchinea, being 2,430 feet, and along its shore is some excellent grass.

We followed the east shore of Azuzetta Lake to its north end, one mile and three-quarters, and then kept along the valley in a north-west direction. After passing a few beaver dams we crossed an open, sloping, grassy prairie, at the base of the right-hand mountain, and noticed, 100 yards to the left, a stream ten feet wide, running northward. On further examination I found that this stream issued from the mountains on the west, and received the drainage of the last small lake or beaver dam we had passed; this proved to be the origin of the west or main branch of Pine River, or Satchaca. The altitude of the summit, near the beaver dam above referred to, is 2,440 feet above sea level.

A mile from the summit brought us to a precipice, or drop, over 100 feet high, stretching across the valley from side to side, down the face of which the pack train scrambled with great difficulty.

The stream finds its way gradually to this lower level through a rugged rocky canon. The valley at this point is about a quarter of a mile wide, with high rocky bluffs on both sides.

For six miles from the summit the general course of Pine River Valley is north-west, and it seemed at one time almost certain that we should be pushed westward by the main range into the valley of the Parsnip, by an opening lying nearly on our course; but this proved to be the valley of a tributary from the north, upon receiving which, the main river turns to the eastward.

About a mile below camp No. 42, or 14½ miles from the summit, in about Lat. 55°, 25' N., and Long. 122°, 32' W, the sandstone structure makes its appearance, and Pine River may be said to be fairly beyond the Rocky Mountain range.

From the precipice up to this point the fall is about uniform, and the river runs on a bed of thin slaty slabs. Short low bluffs of shale and slate appear occasionally on the banks.

The valley is thickly timbered with spruce and balsam of good quality, and is sufficiently wide to admit of easy curvature. The flats bordering the river are in places soft and swampy.

Since leaving Fort McLeod, on the 18th July, we had been travelling through a country almost entirely devoid of trails, and presenting every conceivable obstacle to the passage of a pack train. Day by day our small party toiled from morning till

night in making a passable trail for the animals through fallen timber and over swamps, and sometimes after a hard day's work in chopping, brushing, bridging, etc., we had the indifferent satisfaction of looking back only a mile or two to the curling smoke of the previous camp fire. With incessant labor both men and animals were becoming exhausted. The season was far advanced, and our position was by no means determined with certainty. We were glad, therefore, to adopt the expedient which now was presented of travelling in the river bed and on its numerous shingly bars, taking to the woods only where the river was obstructed by drift piles or too deep for travel.

All the saddle animals were pressed into the packer's service. Yet we cheerfully exchanged the hard and continuous toil of hacking our way slowly through the bush, for the discomfort of the more rapid mode of travelling, involving as it did, wading sometimes for a considerable distance in the deep cold water.

One hundred and thirty seven crossings of the river were made altogether.

In this manner we made good progress till the 21st August, when the river channel had to be abandoned, as the water had become waist deep, and fording the river dangerous.

At 55½ miles from the summit Pine River receives a tributary about its equal in volume from the south. The general upward bearing of the valley of this branch for six or seven miles, at which point it seems to fork, is S. 20° E., and its width averages one and a half miles. Some grassy slopes are seen on the west bank, but the valley generally seems thickly wooded.

Nineteen miles below the middle branch the lower or east branch of Pine River is reached. The east branch is slightly larger than the main river and more glacial in appearance. Below the Forks the river is from 500 to 750 feet wide. The altitude at the Lower Forks is 1,430 feet above the sea.

Between the middle and lower forks is a canon two and one-quarter miles in length, of shelving sandstone, but its course is comparatively straight. A loaded dug-out canoe, managed by one of our Indians, passed through the canon in safety, and no difficulty was experienced in travelling on the grassy slopes above.

From the summit of Pine River Pass to the lower forks the distance is seventy-four and one half miles, and the fall 1,010 feet. With the exception of a few miles at the summit, the valley between these points is generally favorable for railway construction. In the upper part of the valley there would be some short rock cuttings, where spurs from the low, sharp, wooded mountains project into the river, but on the lower portion there are long stretches of level flats, where the work would be very light.

On the 18th of August, about two miles above camp No. 44, and twenty-two miles from the summit, an open alluvial flat was reached on the left bank of the river, and a change in the character of the valley became apparent. Up to this point, which is probably the extreme western limit of the "Fertile Belt," no land suitable for cultivation or settlement was seen east of the mountains.

From camp No. 44 to the canyon, a distance of forty-three miles, Pine River Valley is from one to two miles in width. A very large proportion of the low land in this distance is fit for settlement, and the pasturage in the valley and in the north hill slopes is of the richest description. Grass and pea-vine in profuse luxuriance, with clumps of poplar and pine, cover thousands of acres, rendering this part of the country peculiarly attractive. From the canon to the lower forks the cultivable land is less extensive, but the pasture equally abundant and rich. The country abounds in large game, such as bear, cariboo and moose.

The hill slopes are, in many places, very distinctly marked by unbroken terraces, rising in some instances 1,000 feet above the level of the river. Opposite camp No. 47, and for some distance above and below it these terraces are most noticeable. They are truly parallel, and expose at their outer edges short bluffs of sandstone.

We arrived at the Lower Forks on the 28th August, and the following day made preparations to strike eastward, as Pine River here suddenly turns to the north.

On the 30th we started up the east branch in the hope of finding some lateral valley

from the eastward, by which the summit to the Smoky River might be reached. We ascended the valley for ten miles, when it became evident that it was useless to proceed any further, as the upward course of the valley was west of south, and we had evidently reached the southern edge of the plateau. Beyond could be seen pretty high hills rising roughly from the east bank of the river.

For eleven miles above the Forks the east branch has dug out for itself a narrow valley through the plateau. Rough, broken slopes of clay, sandstone and shale face the river, with shelving slabs of sandstone near the water's edge. The river margin is strewn with lumps of coal, numerous thin seams of which are seen in the face of the bluffs. The average height of the plateau above the river is 500 feet.

At noon on the 31st August we left the east branch and kept a course nearly due east. After passing the north end of a ridge running north and south, we reached a large stream coming from an easterly direction. Following up this stream to its source, through a wide valley, a summit 3,050 feet above the sea was crossed, and a little further on we came to a small stream running eastward, which was followed for seven and one-half miles to camp No. 59, where the stream turns northward. The last five miles we travelled on a good Indian trail, on which were marks of horses, and by the side of the stream we noticed numerous wigwams. At camp No. 59 was found the entire skull of a buffalo.

From this camp we kept on, as nearly as possible, an easterly course, travelling occasionally on an Indian trail. After crossing a low ridge and several tamarac swamps, we reached, at four miles from Camp 59, a sluggish muddy river, 100 feet broad, running north, and no doubt falling into Pine River. Two miles east from this river we made Camp 61, at the foot of a pretty high ridge lying directly across our course. The altitude of this camp is 2,300 feet above the sea, and its distance easterly from the lower forks of Pine River, thirty miles.

From the time we left the east branch we had evidently been travelling along the southern limit of the plateau; for near at hand, on our right, rose hills and ridges from 700 to 1,000 feet above the general level, while the country to the north looked comparatively even. In the vicinity of "Buffalo Creek" the land is good, and the pasturage very rich.

The safety of the mules had now to be taken into consideration. They were 650 long miles from their winter pasturage at Kamloops, and the higher mountains had received, some time ago, their winter coats of snow.

Notwithstanding the never-ceasing attention of the most careful and industrious of cargadores, the animals were very much bruised and fatigued. For fifty-one days, often on scanty fare and with little rest, they had been by turns scrambling along rocky slopes and over fallen logs, breast high, floundering across swamps, or stumbling among the slippery boulders of the Misinchinea and Pine Rivers. Without the train I could do nothing, for the Indians refused to pack, and were besides becoming otherwise troublesome. They were in a strange country, far from home, and for sometime back had been using every means to dissuade me from continuing my journey eastward, at the same time making implied threats of returning home by themselves. I was very anxious to reach the summit to Smoky River; but there was high ground in front of us, and we would have been compelled to deflect still more to the north; besides, the country was much encumbered with fallen timber, and our progress eastward must have been very slow.

It was intended that the pack train should be at Quesnelle not later than the 20th October, as beyond that time it could not be considered safe in the woods. By this arrangement there was now left a margin of only a few days, and, under the circumstances, I judged it best to turn homewards.

We left Camp No. 61, for Quesnelle, on the 7th September, and reached the Lower Forks early on the 10th. On the 11th I examined the river for six miles below the Forks, and next day we started up stream on our homeward march.

In passing, I ascended Table Mountain, from the top of which an extended view was obtained—and the following notes taken respecting the surrounding country:—S. round to S. 80° E, many low hills rising from the plateau 500 to 1,500 feet; S. 80°

E. to N. 60° E., hills gradually flatten; N. 60° E. to N. 15° W., a comparatively level country; N. 75° W., very high peaks distant 40 to 50 miles. (These are no doubt the southerly peaks of the high range in the great bend of the Peace River.) N. 15° W. to S. 70° W., a flat country for 30 to 40 miles, beyond which rise high rough mountains well patched with snow; S. 25° W., up the valley of the middle branch towards the source of the Misinchinea, high snowy mountains. All the country to the south rough and irregular.

From the above observations it is evident that no satisfactory line of railway to the eastward need be looked for, independent of the Pine River valley, as far as the Lower Forks, or to the south of a line bearing N. 60° E. for some distance from the latter point.

The height of Table Mountain is about 3,500 feet above the sea.

On the morning of 16th September, the thermometer (Fahr.), stood at 22° above zero, and the weather looked threatening. We therefore pushed on with all speed, and reached the summit on the 20th. The snow line was then within 400 feet of the valley, and the weather boisterous, with occasional showers of hail.

Parsnip River was crossed on the 26th, and the following day, during a heavy snow storm, we arrived at Fort McLeod, 16 days from the Lower Forks of Pine River.

On the 29th, with the thermometer at 8° above zero, the pack train was despatched to Quesnelle, under instructions to proceed as rapidly as possible.

The train arrived at Quesnelle in safety on the 15th October.

After settling some difficulties with our three Indians, who insisted on returning with the pack train to Fort St. James, I proceeded by canoe to the mouth of the Misichinsinea for the purpose of examining the valley of that stream and ascertaining if a practicable route existed in that direction to the valley of Pine River.

The Misichinsinea falls into the Parsnip River, about ten miles below the Misinchinea. It is about 15 feet wide at the mouth, and its valley for eight miles up is favorable.

Beyond that distance the valley gradually becomes narrower and steeper, and at sixteen miles from the Parsnip branches out into the high rough mountains which lie on the west side of Pine River. A very indistinct Indian trail was followed up the Misichinsinea for ten miles, where it ascended the left hand mountain and was seen no more.

Returning to the Parsnip on the 4th October, on the 5th we started up that river with the object of ascertaining the character of its valley and examining the eastern slope of the ridge between McLeod's Lake and the Parsnip.

During the night of the 4th the thermometer fell to 7° above zero, and we were much hindered by float ice in the river. On the 8th we had reached a point thirty-three miles above the Misinchinea. For this distance the valley of the Parsnip River is flat and wide, and in every respect favourable. The ridge on the east, towards McLeod's Lake, is from 500 to 1,200 feet above the level of the river, and does not seem to present any serious obstacles to a line across it from East to West, were such desired.

At noon on the 8th we turned down stream and reached Fort McLeod by way of Pack River and Tutia Lake on the 10th.

It now remained for me to examine the route by way of McLeod's Lake and Crooked River or Chucaca to Summit Lake, and thence by way of Salmon River to the located line on the Upper Fraser.

We started from Fort McLeod by canoe on the 11th October, at 10 a.m., and entered Summit Lake on the 14th at 11 a.m. For some distance before reaching the lake we had to break our way through the ice. The navigation on a great portion of this route is excellent. The river in many places forms a natural canal, in others it opens out into lagoons and small deep lakes. There are, however, not a few shallow difficult rapids, affording barely sufficient depth of water to float a canoe, and in some portions of its course the windings of the river are interminable.

The adjacent country is generally flat for some distance on each side, and thickly wooded. On the west shores of McLeod's Lake, which is about fourteen miles in

length, the hills are rough but not high, sloping irregularly to the lake. The slopes on the east shore are more uniform, and less steep and broken. The shores of the various lakes are deeply indented by numerous bays and narrow arms, but the promontories thus formed are generally low, and by undulating grades could be crossed near the foot hills.

Rock appears on the east hill slopes at several points, but, generally, this would not interfere with railway location. On the upper portion of Crooked River the country is of a gravelly character; in some places rising in benches fifty to 100 feet above the river.

The distance from Fort McLeod to the upper end of Summit Lake, omitting the many windings of Crooked River, is about sixty miles, and the rise between those points is 160 feet. On a line this would be pretty evenly distributed throughout the whole distance.

The altitude of Summit Lake is 2,050 feet above the sea. Its length north and south is about five miles by four miles east and west. The waggon road across the Giscome Portage from Fraser River, strikes the lake at the south-east corner.

From the west end of the lake to Salmon River the distance by a good trail is only two and three-quarter miles, and the country is comparatively level. The watershed between the Arctic and Pacific Oceans is crossed one and a-quarter miles from Summit Lake, at an altitude of 2,160 feet above the sea.

We hauled our canoe and packed our baggage across this portage and started down Salmon River on the 16th October, reaching the Fraser early on the 18th; Quesnelle on the 19th, and Victoria on the 27th.

I closed my track survey on Division N, location of 1876, at the crossing of Salmon River bench, mark No. 106; altitude, 1915.46.

The valley of Salmon River, from the east end of the portage to the Fraser, is from one half to one and a-half miles wide, and about 200 feet below the general level of the surrounding country. It is thickly wooded with fir and cottonwood. The channel of the river is very crooked and much obstructed by drift piles, which render navigation, more especially at a low stage of water, very tedious. There are a number of sliding slopes and bluffs of clay and gravel at the elbows of the river, and many gravel flats on both sides five to thirty feet above high-water mark.

The approximate position of a line along the route explored, from the railway surveys on the Upper Fraser by way of Pine River Pass to the Lower Forks of Pine River, a distance of 187 miles, is shown on the accompanying plan by a red line. This route is well marked out by the natural physical features of the country, and the following brief notes, with respect more especially to the general grades obtainable, may be useful.

	Distance in Miles.	Grades.	
		Ascending Feet per Mile.	Descending Feet per Mile
From Division N. location up Valley of Salmon River to Summit on Portage.....	12	21	.....
From Summit on Portage to West End of Summit Lake.....	3	.....	37
From West End of Summit Lake to Outlet of same.....	4	.....	Level.
Outlet of Summit Lake to North End of McLeod's Lake.....	54	.....	3
From North End of McLeod's Lake to Tutia Lake at the 80th Mile.....	6	.....	5
From the 80th Mile to Summit of Ridge between Pack and Parsnip Rivers.....	6	33	.....
From the Summit of Ridge to the Crossing of Parsnip River....	2	.....	57
From Crossing of Parsnip River to Crossing of Mistinchinea, near Mouth of Atunatché.....	19	15	.....
From Crossing of Mistinchinea to South End of Azuzetta Lake	4	53	.....
From South End of Azuzetta to Summit of Pine River Pass..	2½	4	.....
From Summit of Pine River Pass to Lower Forks.....	74½	.....	14

For the first 106 miles the works would be mostly in gravel. From the 106th mile there would be some heavy work along the Atunatché, with considerable rock-cutting and probably some tunnelling near the precipice from which, to the Lower Forks, seventy-three and one-half miles, the works would be generally light, with a few rock cuttings.

The crossing of Pine River below the Lower Forks would be 1,200 feet wide, and seventy feet above the river, and some heavy work might be expected along the river slopes in gaining the plateau to the eastward.

Finally, the following may be noted as the salient facts ascertained from this exploration, viz. :

That a depression occurs in the Rocky Mountain range, extending from $55^{\circ} 15'$, to $55^{\circ} 45'$, North latitude.

That a pass exists in this depression which, together with its approaches from east and west, is, with respect to railway construction, of a generally favorable character.

That the summit of this pass is 2,440 feet above the level of the sea, which summit, for the sake of convenient comparison, it may be observed, is 1,293 feet lower than that of the Yellowhead Pass; 1,065 feet lower than the watershed between the Fraser and Homathco Rivers; 660 feet lower than the summit to Dean Channel; and, to carry the comparison a little farther, 5,802 feet lower than the highest point on the Union Pacific Railway.

I am, Sir, your obedient servant,

JOSEPH HUNTER.

MARCUS SMITH, Esq.,

C.P.R. Survey.

APPENDIX H.

CANADA AND ITS VAST UNDEVELOPED INTERIOR,

BY SANDFORD FLEMING, C. M. G.

Read before the Royal Colonial Institute, London, England, 16th April, 1878.

(EXTRACTS.)

“Having mentioned some of the events which ushered in the birth of the new Dominion, it will now be my purpose to furnish in a concise form a general account of the great region embraced within its limits, all of which is under the control of the Canadian Government. As a preliminary it seems proper that I should refer to some of those early discoverers and daring travellers who gave to the world the first knowledge of the country.

Last session, Mr. Fraser, when he addressed the Institute, referred to Sebastian Cabot, who touched the east coast of Labrador so long ago as 1496, and to Jacques Cartier who, in command of two or three French vessels, sailed up the St. Lawrence in 1534, and proceeded to establish trading posts which proved to be the beginning of the old province of Canada, now Quebec. Attention being now directed to a more extended field, in fact, to the northern half of North America, our inquiries must necessarily take a wider range, and embrace discoveries on the Pacific, on the Arctic, as well as on the Atlantic coast.

In the fifteenth century, when the Continent of America was first discovered,* the dimensions of the globe were but imperfectly known. Its circumference was thought to be much less than it has since proved to be, and the newly-discovered land was supposed to be the eastern shores of Asia. Spain and Portugal were then the great maritime powers of the world, and they agreed under a Treaty of Partition founded on a bull issued by Pope Alexander VI, in the year 1494, that the Spaniards should possess exclusive control over the western route to Asia, while the Portuguese should communicate through eastern channels. The question of jurisdiction having thus been settled and stamped with the authority of the highest power in those days, the Portuguese pursued their discoveries to the east by way of the Cape of Good Hope, while the Spaniards endeavoured to find their way, in a westerly direction, through new seas and unknown lands, to India. The Spanish ships cruised along the Atlantic coast of America in the hope of finding their way to the south of Asia. In 1513 the Isthmus of Darien was crossed, and three years afterwards Spanish navigators penetrated the Straits of Magellan; and thus the Pacific Ocean was discovered at two widely separate points.

In 1592, Juan de Fuca is reported to have followed the Mexican and Californian coasts until he reached the broad inlet of the sea which to this day bears his name, and which forms the southern limit of Canada on the western ocean. Eight years after the alleged discovery by Juan de Fuca, Henry Hudson ascertained the existence of a great inland sea accessible from the Atlantic side of the new continent. From Hudson's Bay it was confidently expected that some passage would speedily be found which would enable ships to traverse from the Atlantic to the Pacific and thus shorten the voyage from Europe to Asia.

* Columbus landed on S. Salvador or Watling's Island, on the 12th of October, 1492.

In 1669 the whole region surrounding Hudson's Bay was granted by the British Crown to the society of merchants ever since known as the Hudson's Bay Company, who, after thoroughly exploring its shores, failed in discovering an outlet to the west.

The first civilized men who pierced the interior were probably French adventurers and traders from old Canada, while the whole country was yet in possession of France. A record of the exploits of these men, who, without the slightest previous knowledge of the territory, penetrated among numerous savage tribes, would be of thrilling interest. They passed from the St. Lawrence through the great lakes Huron and Superior, and by the innumerable intricacies of streams, lakes, and portages to Lake Winnipeg. Thence, they passed up the River Saskatchewan to about the 103rd meridian, where they planted their most distant trading post some 2,000 miles from the then colonized parts of Canada.

In 1679, almost two centuries ago, Robert Chevalier de la Sale entertained the idea of finding a way to China through the lakes and rivers of Canada. His expedition set out in the frail canoes of the natives, his point of departure above the rapids on the St. Lawrence, near Montreal, being named, as it is still named, "La Chine," in allusion to the daring project to reach from that point the land of the Chinaman. Half a century later the attempt was renewed. In 1731, Pierre Gauthier de Varennes, under the auspices of Charles, Marquis de Beauharnois, Governor of New France, commanded the expedition, and although he failed to reach the Pacific Ocean, he was the first to reach the Rocky Mountains.

In 1762, Fort La Rouge, close to the site of the present Fort Garry, was an established trading post. Soon after this, the conquest of Canada extinguished French possession and terminated French exploration in the western wilderness. Even the French missionaries, who were the first to preach the Gospel to the aborigines, abandoned the country, and did not resume the work for nearly sixty years.

A hundred years after the grant to the Hudson's Bay Company, one of their agents, Mr. Samuel Hearne, was commissioned to examine the interior. Between 1769 and 1772, that early explorer made journeys on foot and in canoes 1,000 miles westwards from the place of his departure on Hudson's Bay. He discovered Great Slave Lake and other large lakes, and traced the River Coppermine to its mouth.

Exactly a hundred years ago, and in the year before the sad end of one of the most distinguished of navigators and discoverers, Captain Cook touched at Nootka Sound, on the western coast of Vancouver's Island, claimed its discovery, and after remaining there a few weeks, sailed along the coast to Behring Straits.

After an intermission of eleven years, Alexander Mackenzie, in the service of the North West Fur Trading Company, set out on an important exploration of the interior. Between 1789 and 1793, that intrepid traveller discovered the great river which justly bears his name, and followed it to the Arctic Ocean. He ascended the Peace River to its source, was the first civilized man to penetrate the Rocky Mountains, and passed through to the Pacific Coast. This traveller inscribed in large characters on a rock by the side of Dean Inlet, the words—"Alexander Mackenzie, from Canada by land 22nd July, 1793." On the same day that Mackenzie painted that memorable inscription by the side of the Pacific, Captain Vancouver was pursuing his examination of the coast about two degrees further north. A short time before Mackenzie emerged from the interior, Vancouver had visited the spot where Mackenzie slept but one night within sound of the sea. Thus these two distinguished travellers, from opposite directions, and engaged in totally different pursuits, discovered precisely the same place, and by a remarkable coincidence all but met each other.

In 1806, Simon Fraser crossed the Rocky Mountains from Canada, and descended the great river of British Columbia which, in his honour, was named after him. It was my good fortune many years ago to read Fraser's original manuscript journal, then in the hands of his son. I have since witnessed the foaming rapids and boiling whirlpools of that wildest of all large rivers, and I cannot be surprised that not many have attempted, and that still fewer have succeeded, in following in the wake of Simon Fraser from the source to the mouth of the mighty stream. Twenty-two years after-

wards, however, Governor Sir George Simpson made the daring attempt. In 1828 he stepped into a canoe at York Factory on Hudson's Bay, and stepped out of the frail craft some time afterwards at the mouth of the River Fraser, having in the interim traversed the interior, and carried the canoe, as Mackenzie did before him, from the source of Peace River to the great northern bend of the Fraser.

This celebrated traveller, in his journey round the world in 1841, again crossed the northern half of America. His course was by the St. Lawrence, the Ottawa, Lakes Nipissing, Huron, Superior, and by the canoe route to Lake Winnipeg. Then across the prairie *viâ* the Saskatchewan to the Rocky Mountains and by Kootenais to the Columbia River.

In June 1843, Captain (now General Sir Henry) Lefroy arrived at Red River, passed through to Lake Athabasca, and there remained from the middle of October to the end of February following, engaged in meteorological and magnetical observations. In March 1844 he started for Fort Simpson on Mackenzie River, where for several months his time was occupied in similar pursuits.

The north-west passage, a problem which had already baffled the energy and skill of navigators, remained unsolved at the beginning of the present century, and a series of attempts was made to throw light on the gloom which surrounded it. Some of these efforts assumed the forms of expeditions by land, traversing the region which now constitutes part of Central Canada, and therefore call for further notice here. The reference to them must be brief, but the indomitable perseverance and heroic endurance which they developed and displayed, demands a passing tribute to names which will ever be familiar in Canadian and Arctic story.

In 1819, an Arctic land expedition was organized under the command of Captain Franklin. That officer travelled, *viâ* Red River, to Cumberland House on the Saskatchewan, and thence by Fort Chipewyan, Fort Enterprise, and the River Coppermine, to the Arctic Coast. This expedition was marked by frightful suffering and loss of life.

In 1825, Franklin started on a second expedition. Having reached Ontario, he passed, *viâ* Lakes Huron and Superior, to Red River, and thence traversed the country to Great Bear Lake, where he wintered. The following year he pursued his journey to the Arctic coast, *viâ* Mackenzie River.

In 1833, Captain Back, on an expedition in search of Sir John Ross, passed from Montreal to Lake Winnipeg and thence to Fort Reliance, where he wintered; after which he followed the Great Fish River to the Arctic coast.

In 1836, Messrs. P. W. Dean and Thomas Simpson, at the instance of the Hudson Bay Company, started overland from Red River on a joint expedition. They spent the years 1837, 1838, and 1839 in explorations on the northern coast. They joined the surveys of Franklin and Beechey at Point Barrow in Behring Strait, and those of Franklin and Back between the Coppermine and Great Fish Rivers, making the longest boat voyage in the Arctic seas on record.

In 1845, Dr. Rae took his departure from Lake Superior on the breaking up of the winter, passed by the common route to Red River, by Lake Winnipeg to Norway House and thence to York Factory, where he wintered. A year afterwards he wintered at Repulse Bay without fuel, and subsisted with his party for twelve months on food obtained with the gun and spear. He united the surveys of Ross and Parry, a distance of about 700 miles, and made the first long sledge journey performed in that part of the world, the total distance being nearly 1,300 miles.

In 1848, Sir John Richardson, who had already made two overland journeys with Sir John Franklin, made a third in search of that lamented traveller. On the last occasion he was accompanied by Dr. Rae. The two volumes published by Richardson on his return afford evidence of the minute scientific observations made in that part of Canada traversed by these celebrated explorers, and supply ample proof of the value of their labours.

In 1849, Dr. Rae, alone, passed down the River Coppermine, pursuing the object of discovering Franklin with unabated vigour.

In the following year, Dr. Rae renewed the search. He wintered at Fort Confi-

dence, Great Bear Lake; descended the Coppermine River; travelled over ice nearly 1,100 miles, at an average rate of from twenty-five to twenty-six miles a day; and made the fastest long Arctic journey which has ever been known. Subsequently, on the same expedition, he made a boat voyage almost rivalling that previously made by Dean and Simpson.

In 1853 and 1854 this indefatigable and justly celebrated traveller, Dr. Rae, was again in the field. Again we find him wintering at Repulse Bay, living nearly altogether on the produce of the gun, the hook, or the spear. He made another sledge journey of over a thousand miles, and joined the surveys of Dean and Simpson with those of Ross west of Boothia. On this occasion Dr. Rae was so far successful as to set at rest all doubts as to the sad fate of the Franklin expedition. For this the promised reward, £10,000 sterling, was presented to him and his men.

With the exception of a final exploration made in 1855 by Messrs. Anderson and Stewart, who passed down the Great Fish River, this ends the record of overland Arctic expeditions. It cannot be denied that, notwithstanding all the toils, perils, and privations inseparable from them, these expeditions have resulted in failure and disappointment in regard to the main object for which they were undertaken, viz., a north-west passage for ships. They have incidentally, however, given valuable additions to our knowledge of the country, and made important contributions to science.

These various overland Arctic expeditions, of which I have presented but an outline, extended over a period of thirty-six years. But for them the northern regions of Canada would not have been so thoroughly explored. We have now a fair knowledge of the northern coasts, with all their silent and peaceful grandeur, far away from the feverish bustle of busy men. The more Arctic portions of the Dominion are probably destined to remain for ever undisturbed by the hum of industry, and to continue, as Providence has hitherto kept them, with all the characteristics of snow and solitude which mark the landscape in high latitudes.

While investigations were being proceeded with during a series of years in the northern parts of British North America, in connection with the all but futile attempts to find a north-west passage between the Atlantic and Pacific oceans, it was not until a comparatively recent period that special attention was directed to the southern and far more valuable portions of the country.

Between the years 1819 and 1855 the northern districts were traversed in many directions. It was only subsequent to the latter date that regularly organized efforts were made to gain information respecting the country nearer home.

In 1857, on the recommendation of the Royal Geographical Society, Her Majesty's Government sent out an expedition to explore the country between Lake Superior and the Rocky Mountains. It was placed under the command of Captain Palliser, who, with a staff of scientific men, remained pursuing his investigations until 1859. Reports of the highest value were published on the return of the Expedition.

The Government of the late province of Canada likewise sent out an expedition in 1857. Its object was to survey the canoe route between Lake Superior, and the Red River settlement. Messrs. Dawson and Hind, who were in charge of distinct branches of this expedition, pursued their investigations during 1857 and 1858, extending them as far west as the south branch of the River Saskatchewan.

In the same years, 1857 and 1858, Captain Blackiston, at the instance of the Royal Society, was engaged in meteorological and other scientific observations. He began at York Factory, on Hudson's Bay, passed inland to Lake Winnipeg, and thence by the Saskatchewan to the Rocky Mountains.

Other travellers, who were not directly commissioned by the Imperial or Colonial Governments, passed through the country, and on their return added valuable contributions to the general stock of information. In 1859 and 1860 the Earl of Southesk followed the Assiniboine and Saskatchewan valleys to the Rocky Mountains, and some years afterwards gave the public the benefit of his observations. In 1862 and 1863, Lord Milton and Dr. Cheadle crossed from the Atlantic to the Pacific

by the Yellow Head Pass and Thompson River, performing a journey in which they were exposed to perils and narrowly escaped disaster. The volume, "The North-West Passage by Land," published on their return to England, is one of the most charming among modern books of travel. In 1864 we again find Dr. Rae at work. On this occasion he had abandoned the Arctic regions in favour of a more southern journey. He crossed as Milton and Chandle did in the previous years, *via* the Saskatchewan to Tête Jaune Cache, but, unlike them, he turned at this point to follow the Fraser, in place of the River Thompson; finally reaching the Pacific coast.

I ought not to omit to mention Messrs. Douglas and Drummond, both botanists who spent some time in the country, and David Thompson, after whom the River Thompson is named. He was for many years in the service of the Hudson's Bay Company as astronomical surveyor. To his labours we are indebted, to no small extent, for our geographical knowledge of much of the interior.

I should do injustice to the missionaries who have gone forth at different times to Christianize and civilize the native tribes, did I overlook the part they have taken in throwing light on the physical features of the several regions they have visited. Ministers of the Anglican, Wesleyan, Presbyterian, and Roman Churches have each and all done their part. To French clergymen of the last-named Church we are perhaps chiefly indebted. Nearly a hundred and fifty years ago Pierre Arnaud, on his first intercourse with the Indians, fell a victim, together with one of the brothers Verandrye and party on their way between Lake Superior and Red River. Canada owes much also to the learned Archbishop Taché, whose travels during a sojourn of over thirty years have been extensive, and the results of whose observations in many parts of the far interior have been given to the world.

This brings the list of the principal explorers, as far as I have been able to learn their names, and the record of the various independent discoveries which have been made, up to the period when the whole territory formerly known as British North America came under the name and jurisdiction of Canada. As I before mentioned, the Imperial Act by which British Columbia and the Hudson's Bay Territory entered the Dominion, came into force in July, 1871. On that day, strong engineering parties were sent out by the Government of Canada to explore the whole region intervening between the seat of Government at Ottawa in the eastern provinces and the Pacific coast at the west. The object was to obtain more complete information respecting the country, and find a line to be followed by a trans-continental railway. The engineering force engaged in this work has been about a thousand men of all grades. The surveys have been continued from 1871 up to the present time. I have been myself intimately connected with it, and therefore it behoves me to refrain from saying much with respect to the manner in which the work has been done. I may, however, be pardoned for alluding to the earnestness and determination of the Government and people of Canada with respect to the development, as rapidly as possible, of the magnificent country which has come under their control. An instance may be given in connection with the surveys. After three years had been spent by the engineers in exploring every part of a wild, uninhabited, and roadless country, extending a distance of about three thousand miles, a great amount of exact engineering information had been obtained at a heavy cost, when a serious and discouraging disaster occurred. In 1874, in mid-winter, the building in which were deposited the field note-books, the unfinished plans, and nearly all the other information accumulated, was destroyed by fire, and nearly every scrap of paper was consumed; and thus the labour of three years, and results which had been obtained at a cost of about £300,000 sterling were lost. Nothing daunted, the order was given to begin the work of surveying afresh. It has been vigorously prosecuted up to the present time, and I can now point to some of the results as being highly satisfactory.

I shall not attempt to weary you with even an outline of the details of the work which already fills volumes; I will simply allude presently to the general information which has been acquired, showing, perhaps, some of the more important results which have been obtained. It will, however, enable the members of the Institute to form some idea of the labour which has been expended on this survey when I inform them

that the total length of explorations made during the last seven years exceeds 47,000 miles, and that no less than 12,000 miles have been laboriously measured by chain and spirit level, yard by yard, through mountain, prairie, and forest. To mention that the Canadian Government has, on this special examination alone, expended about £700,000 sterling, will not fully convey a correct idea of the energy and determination displayed.

Besides extensive land surveys in Manitoba, the boundary line between Canada and the United States has been defined from end to end. This was done by a joint Commission appointed by both countries; the British section of the Commission being in command of Major D. R. Cameron. The work occupied three years, and the reports furnished on its completion, including scientific papers by Captains Anderson, Featherstonhaugh, and George M. Dawson, have largely extended our knowledge of that portion of the country adjoining the southern boundary line from the Lake of the Woods to the Rocky Mountains. A boundary survey west of the mountains had been previously effected.

The foregoing sketch of the early discoveries of different independent portions of North America which together make up the Dominion of Canada, and the reference to the various explorations and surveys which, from time to time, have been made in different parts, will enable members of the Institute to judge of the value of the information, geographical and physical, which has been acquired respecting much of the country. The several provinces on the Atlantic sea-board, and the valley of the St. Lawrence are well known, and have already been described at a former meeting. The southern margin of the country, extending from these provinces westwards to the mountains, have been examined with the greatest care by the Royal Commission appointed to define the boundary between Canada and the United States. The Canadian coast on the Pacific, with its many deep fiords, flanked in some instances by mountains reaching the limits of perpetual snow, has been the subject of repeated explorations. The northern side of the country, with its long summer day and its equally long winter night, has been visited in nearly every part by brave indefatigable men, who, after perils and privations of no ordinary kind, have mapped it out, and left it again to the silence and desolation which pervade the Arctic circle. The interior is so vast that it cannot be said to have been completely examined. There are still some districts where the foot of civilized men has not yet stepped; but, as I have shown, explorers have forced their way in many directions; adventurous men have penetrated the gloomy recesses of the primeval forest, have peered into the rocky fastnesses of the mountains, and, with unflagging toil and unflinching endurance, have gained for us a general and reasonably correct knowledge of much of the country.

I shall not trouble you with many details, but shall endeavour only to lay before you a very brief and condensed description of the general physical characteristics of the several great divisions of the territory comprised within the limits of the Dominion. In the first place it is important that a perfectly clear and correct conception should be formed of its extent. If we open an ordinary atlas and overlook the parallels of latitude and longitude, for the moment, all countries appear very much about the same size. Scales and projections are adopted to suit the convenience or fancy of the publisher. Large countries are made small, and small countries are made large, to suit the size of the book; and thus strange misconceptions are often formed. If, however, we take a large terrestrial globe upon which all the land and water on the earth's surface are depicted on precisely the same scale, our ideas will be corrected. If on the surface of the globe we draw on one sheet of tracing paper the outlines of Canada, and on another the outlines of Europe, and then proceed to lay the one over the other, so as to cover so much of the land in each case as possible, and if we go on to measure and make allowance for portions left uncovered, we shall find that Europe somewhat exceeds the area of Canada, but that the excess is not great. Lest it be imagined that Canada has an undue share of the region of ice and snow, we may exclude from the comparison all the land within the Arctic circle in both cases, and still we find that Canada covers fully more of the

earth's surface than the comprised areas of European Russia, Lapland, Norway, Sweden, Denmark, Holland, Belgium, the British Islands, France, Switzerland, Germany, Austria, Turkey, and all the principalities between the Adriatic and Black Seas; in fact, if we leave out Spain and Italy, Canada appears to equal in area the remainder of Europe.

Of course, this is a comparison simply of extent; it has no reference to soil, or mineral resources, or to climate. These features will be briefly considered presently.

It has been found convenient in describing the general characteristics of Canada to divide it into three great regions. Its leading botanical, geological, and topographical features suggest this division. One region, except where cleared of its timber by artificial means, is densely wooded, another is wooded and mountainous, the third is a vast lowland plain of a prairie character. The Mountain Region is on the western side; the Prairie Region is in the middle; the remainder, which embraces the settled provinces on the St. Lawrence, originally covered with a growth of timber, may, for the sake of simplicity of description, be considered the Woodland Region.

I shall first consider the Prairie Region. If we place before us an orographical map of North America, it will be noticed that a great continental plain stretches north and south between the Gulf of Mexico and the Arctic Ocean. It is bounded on the western side throughout its whole extent by the Rocky Mountain zone, and on the eastern side in part by a less elevated region, the Appalachian zone. This great plain occupies the whole of the continent of North America between the western and eastern mountain ranges. It is divided by its river systems into three perfectly distant drainage basins. One drains to the south into the Gulf of Mexico, another north into sub-Arctic waters, and the third east into the Atlantic by the channel of the great river St. Lawrence.

Of these three basins, that of the St. Lawrence is by far the smallest, and the northern is fully as large as the other two together. The St. Lawrence basin, on the boundary between the United States and Canada, occupies part of both countries; the southern basin is almost wholly in the United States; the northern basin is almost wholly in Canada; and the line of contact between the two latter basins is in part approximately coincident with the 49th parallel of latitude—the southern limit of the interior of Canada. It will thus be seen that the great continental plain of North America is divided naturally, as well as artificially, through the centre. It is divided politically into two adjacent countries, under distinct governments, and naturally into three vast drainage basins, the smallest of which occupies a comparatively narrow strip along the eastern portion of the International Boundary line, while the other two discharge their waters in diametrically opposite directions.

The Prairie Region of Canada, lies in the northern drainage basin: it may be considered to extend from south to north more than a thousand miles, and nearly the same distance from east to west. It is not all a treeless prairie; a considerable portion is thinly wooded; yet the whole is considered as more or less partaking of a prairie character.

The Prairie Region, so called, is somewhat triangular in form. One side coincides with the International Boundary line, and extends from the 95th to the 113th meridian; another side follows the eastern slope of the Rocky Mountains from the 49th to about the 64th parallel of latitude. The third side, about 1,500 miles in length, skirts a remarkable series of lakes, rivalling in size Lakes Erie and Ontario. These great water-filled depressions lie in a generally straight north-westerly and south-easterly direction. They embrace Great Slave Lake, Lake Athabasca, Lake Wollaston, Deer Lake, and Lake of the Woods, and they appear to occur geologically on the separating line between a broad band of Laurentian or metamorphic rocks and the softer Silurian formations. This great triangular-shaped region is estimated to measure about 300,000,000 acres. Its base, running along the series of lakes mentioned, will probably average less than 1,000 feet above the sea; and its apex, near where the International Boundary line enters the Rocky Mountains, will probably be about 4,000 feet above sea level. This region may generally be described as a great plane sloping from its apex in a north-easterly direction downwards to its base, but

the inclination is not uniform and unbroken. Several terraces and well-defined escarpments stretching across the country are met with at intervals. A great proportion of the surface is gently rolling, and hills of no great height occur here and there. The rivers of this division of the country flow for a great part of their course in deeply eroded channels, frequently of considerable width, and as the superficial formations are for the most part drift or soft rock, the channels which have been furrowed out are but little obstructed by falls or steep rapids. They generally present a uniform descent, and the long stretches of some of the rivers, although the current be swift, are capable of being navigated. A wide expanse of the region to the south of the main Saskatchewan is a prairie, without trees or shrubs of any kind; the treeless prairie passes by easy gradations into copse woodland with prairie intervening. To the north of the Saskatchewan, woodland appears in various localities. On Peace River there are extensive prairies; there is, also, an agreeable mixture of woodland and prairie; and this character of country appears to prevail for a considerable distance still further north.

It is scarcely to be supposed that a region so extensive would be found all fertile land. The great American desert, which covers a wide area in the centre of the United States, was at one time thought to extend north for a considerable distance into Canada. The Boundary Commission reports, however, appear to show that the arid and unproductive tract is more limited on the Canadian side than was previously supposed; and that a great breadth of the country previously considered valueless may be used for pastoral purposes, and some of it ultimately brought under cultivation. There are other places within the territory described as the Prairie Region which are unfavourable for farming pursuits; and although certain drawbacks claim recognition, there can no longer be any doubt respecting the salubrity of the climate and the existence of vast plains of rare fertility. Information on this head has been obtained year by year. Professor Macoun, a well-known botanist, has recently been commissioned specially to investigate this subject. He estimates that there are no less than 160,000,000 acres of land available in this region alone for farming and grazing purposes, of which one-half, or 80,000,000 acres, may be considered fit for cultivation.

The mineral riches of this great division of Canada are but imperfectly known. It has, however, been established that immense deposits of coal exist in many parts, chiefly along the western side. The examinations of Mr. Selwyn, director of the Geological Survey, carry the impression that the coal bearing rocks pass with their associated coal seams and iron ores beneath the clays farther east, and it may be that shafts would reveal workable seams of coal at such limited depths beneath the surface as would render them available for fuel and for industrial purposes in the heart of the prairies. Should these views of Mr. Selwyn prove correct, their realization will be of the greatest possible importance to the country. Besides coal and iron ore, petroleum, salt and gold have also been found.

The nucleus of a population has for many years existed on the Red River; it was originally formed by the Earl of Selkirk near the beginning of the present century. In the autumn of 1812 he reached the chosen locality, Kildonan, *via* Hudson's Bay and River Nelson, with a small party of Highland Scotchmen. Subsequently, the numbers were increased, and a number of French Canadians also settled down to cultivate the soil at St. Boniface, on the opposite bank of the Red River. The Red River settlers, exposed to many vicissitudes during a space of half a century, did not greatly prosper. But since the incorporation with Canada of the whole country formerly under the sway of the Hudson's Bay Company, marvellous progress has been made. The province of Manitoba has been created around the place which was once the Selkirk settlement; its population has increased from a mere handful to many thousands, and it has to all appearance entered on a career of unexampled progress.

Manitoba, although a province with prospects so brilliant, occupies but a small corner of the fertile lands in the interior of Canada. The Prairie Region, as set forth in the foregoing, is alone ten times the area of England, reckoning every description of land; such being the case, it may be no vain dream to imagine that in due time

many Provinces will be carved out of it, and that many millions of the human family may find happy and prosperous homes on these rich alluvial plains of Canada.

I shall now pass to that other great division of the country which has been designated the Mountain Region.

This is part of the great elevated mountain zone of North America, which begins in the Cordilleras and elevated plateau of Mexico, and extends to the Arctic Ocean. If we examine the orographic map, it will be observed that the Rocky Mountain zone, although it has many subsidiary mountain ranges, is characterized for the greater part of its length by two prominent and perfectly distinct Alpine chains, each with many spurs or branches. One of those main chains is directly along the Pacific coast: in Canada it is known as the Cascade Mountains, and farther south as the Sierra Nevalas. The other range is the Rocky Mountains proper: it observes a general, although not perfect, parallelism with the coast. The distance between the crests of these two lofty chains varies from 1,000 miles in the United States to 300 miles in Canada, and to this circumstance may be attributed the remarkable widening of the alluvial plains in the Canadian half of North America.

I shall now confine my remarks to that portion of the Rocky Mountain zone within the limits of Canada.

The Cascade Chain rises abruptly from the sea level, presenting from the water an extremely bold and defiant aspect. The average height of the many serrated summits will probably range from 5,000 to 8,000 feet above sea level, and some of its central crests and loftiest peaks rival in elevation the main Rocky Mountain Chain. The main Rocky Mountain Chain is in Canada from 300 to 400 miles distant from the Pacific coast. This chain rises like a colossal wall above the continental plain on its eastern side. Its flanks are, however, deeply gashed, and great countefort-like spurs jut out, between which the rivers which water the Prairie Region take their rise. Much of this great mountain barrier rises over 8,000 feet above sea level. The loftiest central peaks enter the region of perpetual snow; some of them, indeed, reach an elevation estimated at 15,000 feet above the ocean. On the western flank of the chain are several independent groups of mountains, known by local names. They are separated from each other by narrow valleys and deep chasms, some of which are prolonged in the direction of the Prairie Region, forming passes through the mountains. Some of these passes are from 6,000 to 7,000 feet above the sea, and they range down to less than 2,000 feet. These transverse openings through the lofty chain afford comparatively easy passages from one side to the other. The lowest and most remarkable is in about latitude 56 degrees. Here the Peace River rises on the western side of the Rocky Mountains, and flows through them at a low altitude, ultimately passing into the River Mackenzie.

Between the Cascade and Rocky Mountain Chains there extends an elevated plateau, averaging from 3,000 to 4,000 feet above sea-level. This plateau is grooved out by deep river channels, broken by rocky ridges and inferior mountain masses. It has many lakes, occupying deep depressions in the surface, and is intersected in many directions by numerous broad, sheltered, undulating valleys. The surface of this plateau in some quarters is thickly, in others scantily, timbered, and in certain districts open prairies present themselves.

Off the shore of the mainland there are several large islands, the most important of which is Vancouver Island; the others are the Queen Charlotte group. The former is half as large as Scotland, the latter is in area more like Wales. The climate of these islands is moist and temperate, and in this respect they are not dissimilar to the British Islands. Vancouver, the most southerly, has an elevated interior with mountains rivalling in height those of the mother-country. Some of the central peaks, such as the Alexandra, the Albert Edward, and the Victoria, rise from 6,400 to 7,500 feet above the sea. The last, the Victoria Peak, is double the height of Snowdon, and one-third higher than Ben Nevis.

Besides Vancouver and the Queen Charlotte group, there exists along the shore of the mainland clusters of smaller islands, between which are deep, and in many places intricate passages. Great arms of the sea pierce the mainland in many

places. They resemble the deep-water, rock-bound fiords of Norway, and they penetrate so far that the largest iron-clads afloat could steam, in some cases, into the very heart of the Cascade Mountains.

The Mountain Region has some good lands, but the fertile tracts are limited in extent; when developed they will be advantageously situated for raising agricultural products and stock to supply the mining industries which in time will undoubtedly be established.

This region is exceedingly rich in minerals, containing coal and iron in profusion. In quality, the Vancouver coals are found superior for steam engines to any worked on the Pacific coast. They find their way to California, and are used on the railways leading out of San Francisco, in spite of a high duty imposed by the United States. The precious metals are also found. The yield of the gold washings is already about 40,000,000 dollars, and within the past year quartz mining has been inaugurated. Mr. Dawson, of the Geological Survey, reports: "I think it may be said without exaggeration that there is scarcely a stream of any importance in the province of British Columbia in which the 'colour' of gold is not found." Silver is met in several localities. Copper, mercury, lead, platinum, and nickel are also mentioned in the reports of the Geological Survey.

Very much still requires to be learned respecting the rock formation of the Mountain Region. Data have, however, been collected in a rapid and necessarily imperfect geological exploration sufficient to establish the existence of great mineral wealth. There can be no doubt that here we have a wide and promising field, and the future will witness industries of various kinds working and developing the riches which lie buried under the surface. The forests, of enormous growth, which exist in many places, and the fisheries of the rivers and coasts, will give employment to a very considerable population.

I must now turn to the Woodland Region; but to describe it, even in outline, would far exceed the limit of this paper; I must therefore content myself with a few passing remarks. I have already defined the Woodland Region to be the whole of Canada not within the Mountain Region in the west and the Prairie Region in the middle; it therefore embraces all the settled portions of the Eastern Provinces which were wooded at one time, but which have, within a brief period, been in part cleared by the hand of man. This region is of immense extent; it embraces 84 degrees of longitude; its most southerly point is on Lake Erie, in the 42nd parallel, and it stretches from the latitude of Rome away far north to a point at least 200 miles within the Arctic circle. Compared with the country on the Pacific coast, no part of this region can be considered mountainous. Although elevated ranges, like the Laurentides, are met, only a small proportion of the country exceeds 2,000 feet above sea-level. An area of fully 200,000 square miles is estimated to be under 500 feet above the level of the sea.

So great an extent of territory presents many varieties. In the north it assumes an Arctic character, and resembles portions of Siberia. The nearest portion of Canada to Europe is that which is least known and believed to be the least valuable. It is bounded on the west by Hudson's Bay, and on the east by the Atlantic Ocean. Its extreme length from north to south is about 1,000 miles, and it is about the same length from east to west. This section of Canada is somewhat greater in area than Norway and Sweden, Denmark and Lapland, and a great extent of it is considered to have no better climate than the northern parts of these European countries. To the north-west of Hudson's Bay about an equal area may be similarly described. Its surface is varied, and its vegetation affords sustenance for the great herds of reindeer and musk ox which find a home in this otherwise inhospitable section. It presents no prospect for the agriculturist; the only hope is in the fisheries along the coast, in the fur trade, and possibly in minerals which may lie hidden under the surface.

These are the worst sections of the country; as we advance southward its character gradually changes and improves. True, there is a broad band, the agricultural resources of which are not promising; but the forests which cover the surface will every year become more and more valuable, and its geological structure affords indi-

eations of mineral wealth. The investigations of the Geological Survey here point to the existence of rich deposits extending over wide areas. The more important minerals are gold, silver, coal, iron, copper, lead, phosphates, and plumbago. Crossing the metalliferous band, we reach considerable tracts of land which by cultivation will produce all the ordinary crops; and continuing southwards we finally reach Ontario, one of the finest wheat-producing countries in the world.

I must say a word about the climate. It should be borne in mind that Canada, like Europe, extends over so many degrees of latitude that it must have many gradations of climate. In some parts of Canada, fruits ripen in the open air that cannot successfully be grown in England in any quantity except under glass. In one locality every farmer enjoys the luxury of a large peach orchard; while far to the north the flora and fauna are those of Lapland, and still farther north icebergs are the perennial crop. The alpine region bordering the Pacific, as in Southern Europe, presents lofty peaks reaching the permanent snow-line, while at lower levels in the vicinity of the ocean a climate soft and mild as Ireland prevails.

In the greater part of Canada, however, the thermometer has a wide range. In summer the temperature runs high; in winter it occasionally goes very low. It is difficult for a resident of this country to understand how one can live and enjoy life in a temperature sometimes many degrees below zero; but owing to the extreme dryness of the atmosphere the cold is not really felt so much as might be imagined. Ordinary work is carried on in the open air without inconvenience in what would seem to a resident in England very great degrees of cold.

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Generally speaking, the climate of habitable Canada may not unfairly be compared with that of Russia, Germany, Austria, and other countries in Europe. It cannot be denied that the winters are perhaps longer and colder than is desirable. The climate is certainly continental, but notwithstanding the wide range of temperature, there cannot be a doubt that it is not only endurable, but that it is healthy and bracing.

Viewing Canada as one consolidated country, extending across the widest and not the least valuable portion of the continent of America, embracing a marvellous breadth of fertile and unoccupied land; with a healthy, invigorating climate; with unlimited mineral resources; with supplies of timber in her forests second to those of no country in the world; with inexhaustible fisheries in its great lakes and rivers, and around its coast on three oceans; with deposits of coal and iron of unmeasured extent in the interior of the country, and on the Atlantic as well as on the Pacific sea-boards; taking all these natural elements of future wealth and greatness into consideration, the problem which presents itself is the development of a country which has been provided with natural resources so lavishly. The question is, how to colonize the northern half of North America, and render it the home of a happy and vigorous people. It is true that Canada already has a population of some four millions, but as yet the mere outer fringe of the country is occupied. We are only beginning to realize the fact that the interior has space for many times the present population. It is just beginning to dawn upon Canadians themselves that in the territories which have been described, there is room, and to spare, and there exist the elements of support, for a greater population than that of the mother-country. No wonder, then, that the problem to be solved appears one of weighty importance.

The waterways of a country present the natural means of colonization. In bygone times, rivers and lakes, the shores of bays and estuaries, have been followed by adventurous races, and these natural channels have thus in all ages furnished the means of spreading the human family. Canada is not wanting in highways of this kind, although many of them are subject to drawbacks which will presently be referred to. On the eastern side she has the Gulf of St. Lawrence, which in many respects resembles the Baltic. To the north she has Hudson's Bay, a sheet almost half as large as the Mediterranean. She has lakes, but they are really seas, and they breed storms and tempests like the Atlantic. I might attempt to describe a dozen of these inland fresh-water seas, but I should fail to convey a correct idea of their character and importance.

Fortunately I can refer to a description of the waterways of Canada by a master-hand. I cannot, I am sure, quote higher authority than that great traveller and distinguished nobleman, the Governor-General. On a recent occasion, Lord Dufferin, standing as near as possible midway between the Atlantic and the Pacific, and addressing some of the subjects of Her Majesty in the province of Manitoba, said:—

“To an Englishman or a Frenchman, the Severn or the Thames, the Seine or the Rhone, would appear considerable streams; but in the Ottawa, a mere affluent of the St. Lawrence, an affluent, moreover, which reaches the parent stream 600 miles from its mouth, we have a river nearly 550 miles long, and three or four times as big as any of them. But, even after having ascended the St. Lawrence itself to Lake Ontario, and pursued it across Lake Huron, the Niagara, the St. Clair, and Lake Superior to Thunder Bay, a distance of 1,500 miles, where are we? In the estimation of the person who has made the journey, at the end of all things, but to us who know better, scarcely at the commencement of the great fluvial systems of the Dominion, for from that spot, that is to say from Thunder Bay, we are enabled at once to ship our astonished traveller on the Kaministiquia, a river of some hundred miles long. Thence, almost in a straight line, we launch him on to Lake Shebandowan, and Rainy Lake and River—the proper name of which, by the by, is ‘Rene,’ after the man who discovered it—a magnificent stream 300 yards broad, and a couple of hundred miles long, down whose tranquil bosom he floats into the Lake of the Woods, where he finds himself on a sheet of water which, though diminutive as compared with the inland seas he has left behind him, will probably be found sufficiently extensive to render him fearfully sea-sick during his passage across it. For the last eighty miles of his voyage, however, he will be consoled by sailing through a succession of land-locked channels, the beauty of whose scenery, while it resembles, certainly exceeds the far-famed Thousand Inlands of the St. Lawrence. From this lacustrine paradise of sylvan beauty we are able at once to transfer our friend to the Winnipeg, a river, the existence of which in the very heart and centre of the continent, is in itself one of Nature’s most delightful miracles, so beautiful and varied are its rocky banks, its tufted islands; so broad, so deep, so fervid is the volume of its waters, the extent of their lake-like expansions, and the tremendous power of their rapids. At last, let us suppose we have landed our traveller at the town of Winnipeg—the half-way house of the continent, the capital of the Prairie Province, and I trust, the future ‘umbilicus’ of the Dominion. Having had so much of water, having now reached the home of the buffalo, like the extenuated Falstaff, he naturally ‘babbles of green fields,’ and careers in imagination over the prime al grasses of the prairie. Not at all. Escorted by Mr. Mayor and the Town Council, we take him down to your quay, and ask him which he will ascend first, the Red River or the Assiniboine, two streams—the one 500 miles long, the other 480—which so happily mingle their waters within your city limits. After having given him a preliminary canter upon these respective rivers, we take him off to Lake Winnipeg, an inland sea 300 miles long and upwards of sixty broad, during the navigation of which for many a weary hour he will find himself out of sight of land, and probably a good deal more indisposed than ever he was on the Lake of the Woods, or even the Atlantic. At the north west angle of Lake Winnipeg he hits upon the mouth of the Saskatchewan, the gateway and high road to the North-West, and the starting point to another 1,500 miles of navigable water, flowing nearly due east and west between its alluvial banks. Having now reached the foot of the Rocky Mountains, our ‘Ancient Mariner’—for by this time he will be quite entitled to such an appellation—knowing that water cannot run up hill, feels certain his aquatic experiences are concluded. He was never more mistaken. We immediately launch him upon the Athabaska and Mackenzie Rivers, and start him on a longer trip than he has yet undertaken, the navigation of the Mackenzie River alone exceeding 2,500 miles. If he survives this last experience, we wind up his peregrinations by a concluding voyage of 1,400 miles down the Fraser River, or, if he prefers it, the Thompson River to Victoria, in Vancouver, whence, having previously provided him with a first-class return ticket for that purpose, he will probably prefer getting home *via* the Canadian Pacific. Now, in this enumeration, those who are acquainted with the country are aware that, for the sake

of brevity, I have omitted thousands of miles of other lakes and rivers which water various regions of the North-West—the Qu'Appelle River, Belly River, Lake Manitoba, the Winnipegosis, Shoal Lake, &c. along which I might have dragged and finally exterminated our way-worn guest, but the sketch I have given is more than sufficient for my purpose; and when it is further remembered that the most of these streams flow for their entire length through alluvial plains of the richest description, where year after year wheat can be raised without manure or any sensible diminution in its yield, and where the soil every where presents the appearance of a highly-cultivated suburban kitchen garden in England, enough has been said to display the agricultural riches of the territories I have referred to, and the capabilities they possess of affording happy and prosperous homes to millions of the human race."

Lord Dufferin did not allude to the artificial waterways of Canada. Compared with some of the lakes and rivers, the canals are, indeed, unimportant; but they will stand comparison with any works of their class. As engineering achievements, I believe I am correct in saying that they are unrivalled. They are certainly as much superior to the canals of the United States, as the latter are in advance of anything I have seen in England. These canals exist only in the province which lie in the valley of the St. Lawrence, still they are of immense value as links in a great chain of navigation, on which during part of the year the products of field and forest are floated to market.

However valuable the natural waterways of Canada may be, they are open to one serious drawback. They are, as may be supposed, exposed to climatic influences, and the low temperature I have referred to, has the effect in the still, brilliant nights of early winter, of sealing them up until the sun again begins to return to the summer solstice.

The early settlement of the provinces was effected by means of the rivers, and bays, and lakes. There were no railways in those days: the hardy pioneers, axe in hand, landed on the forest-clad banks, and cut out homes for themselves and their children. In the four or five winter months they became completely isolated from the outer world, and from all but their nearest neighbours. In consequence, the progress of settlement was but slow, and it was confined mainly to a narrow margin of land along the navigable water channels. It was not until railways were introduced that the progress of the provinces was so marked. These lines of communication, performing their functions independently of climate, connecting all parts of the old settlement, and penetrating wide tracts of land not previously accessible, have given Canada an enormous impulse, and established the conviction that the great interior, to be prosperous, if colonized at all, must eventually be traversed not simply by one railway, but by many railways. The great water-ways will do their part during the open season in assisting to colonize the vast unoccupied regions that are fitted for the homes of men, but they alone would be utterly insufficient. If existing railways have proved so advantageous to sections of the country provided with navigable water channels, and at no great distance from tide water, such as the settled portions of the province of Ontario, railways become indispensable to the western fertile regions not so favourably situated. In the great internal cultivable territory, therefore, it is clear that a system of railways must be considered necessary, in order to provide for its occupation by the many millions it is capable of supporting.

We have already had some experience in railways in Canada, as their construction has been progressing for the past twenty-five or thirty years, and we have found it important to regard with attention the principles which should govern their establishment in new districts. I shall not enter into mistakes which have undoubtedly been committed in the past, by which a great deal of money, public and private, has been sunk and wasted; but in the remarks which follow, it will be observed that due regard is had to the experience gained in those matters, and to the importance of avoiding such fatal mistakes as the building of lines which would injuriously compete with each other, or the sinking of money prematurely in the completion of any lines long before they are wanted.

In carrying railways through unsettled regions, we are called upon to solve a problem differing in essential circumstances from that which has to be considered in laying down lines in old districts already well populated. In the latter case the work is designed practically to diminish distance by the use of high speeds. A heavy expenditure to attain high speed is justifiable, as traffic already exists which will immediately render expenditure productive of revenue. In an unoccupied country, the circumstances are entirely different. Traffic, without which there can be no revenue, has to be created, and the question is complicated by the consideration that the railway itself is indirectly the chief means by which traffic is expected, in process of time, to be developed. There is a marked difference in the necessities of the two cases. In the inhabited country the railway is an after-thought, and high speed is the prime necessity which calls the line into being. In the unoccupied country a certain means of communication is of first importance, and if high speed cannot be obtained without involving an outlay that would prove burdensome, those concerned must, for a time, be contented with a less perfect low speed line until the population becomes sufficiently numerous and wealthy to call for high speed. Such being the case, it seems wise to keep in view from the very first three important considerations :—

1. Certainty of communication at all seasons.
2. The expenditure of no more unproductive capital than may be absolutely necessary.
3. The possible necessity for a high-class railway ultimately, and the importance of securing it without any waste or misapplication of capital in carrying into execution preliminary or intermediate works.

By a high class railway in the third consideration, must be understood a line so perfect that not only high speed may be attained with safety and certainty, but that the actual cost of conveying passengers, as well as products of all kinds, may be reduced to the lowest possible rates. I may say that I have no faith in what are sometimes erroneously called cheap railways. The true cheap railway is the one that can with profit do its work cheaply. I would advocate the utmost economy in expenditure, but at the same time the kind of perfection referred to should be kept prominently in view.

The Pacific Railway has been projected for the double purpose of connecting the Atlantic and Pacific sides of Canada, and the opening up of the interior for settlement. This project has been the subject of much discussion in Canada; it has entered into the realm of politics, and opposite parties, although agreeing with respect to the great desirability of the line, have not agreed as to the means of securing it. As an individual, simply, I may hold views that do not harmonize with those of either party, or of any person, but I shall nevertheless, from an individual and perfectly independent standpoint, endeavour briefly to lay my views before you.

The whole country between the settlement in the Ottawa valley and the coast of British Columbia has as yet very few civilized inhabitants. There are, according to various estimates, probably from 8,000 to 12,000 souls in occupation of portions of British Columbia, and within the past few years settlers have begun to pour into the Prairie region in the province of Manitoba. There are also a few hundreds established on the north shore of Lake Superior. Taken altogether, there are probably not more than 40,000 within a very considerable distance of any part of the 3,000 miles of railway projected. It is perfectly evident, therefore, that the construction of the Canadian Pacific Railway, in the present condition of the country, is a very serious undertaking, and one requiring grave consideration. I have no doubt whatever that it will at no distant day be a work accomplished; that it will form not only a connecting link between the old half-dozen provinces on the Atlantic and the still greater number of provinces which have yet to come into existence in the west, but that it will constitute an important part of a great Imperial highway extending between the heart of the Empire in England and its important outlying portions and dependencies on and beyond the Pacific.

The Pacific Railway being projected for a double purpose, it may not be without profit to consider its objects and to view it firstly as a colonization line, secondly, as a through national line.

Firstly. The experience which we have gained in Canada has tended to establish several sound economical principles in connection with the building of colonization railways in new territories. Some years ago, a scheme based on these principles was projected which commended itself to my judgment, and which, in part at least, has since been sanctioned by the Government. It was termed the Territorial Road Scheme; and as it may possibly be capable of application with advantage to other countries, such as those Colonies where much land yet remains to be occupied, it may not be without interest to members of the Institute. I shall venture, therefore, briefly to notice it.

First of all it is assumed that railways will ultimately be required and built in every district where the natural resources of the country, although for the present dormant, are capable by the application of human industry, of producing traffic which would render steam power as a means of transit necessary and profitable. Supposing we have to colonize a territory fulfilling these conditions, the first step is to discover by thorough surveys the very best position for the future railway system which the prospects or possibilities of the country would seem to demand. The system of lines thus to be projected may consist of a single trunk line with branches at proper intervals, or it may be a number of lines running in the direction which traffic would seek, or in which, in the public interest, it would be desirable to lead it. It is considered important to take this step in advance of settlement, because even a few settlers frequently acquire considerable influence in a new country, and, as is sometimes the case, they may succeed in warping or twisting a trunk line away from the most advantageous position to another and inferior position, in order to suit their adventitious and purely local circumstances. Thus, general interests which, in the future may be of the greatest importance, may suffer through comparatively insignificant local interests unduly magnified for the moment. Having fixed upon the lines upon which the railways, some time or other, are to be built, the next step is to select at proper intervals the most suitable points for the stations, and from these, and these only, to project all the branch roads of every class that are likely to be required.

Thus, the road system of the country to be colonized is proposed to be projected, and the position of the several lines definitively fixed; but as the line of railway may, in some instances, be used for many years as an ordinary road before it is finally converted to the requirements of steam communication, and as it could scarcely be designated a railway until it becomes one, the term "territorial road" was suggested. This term it was proposed to apply to all trunk lines destined ultimately to become railways.

Having established the position of the territorial roads and the points on them for future railway stations, the next step is to lay out at the latter points sites for villages and towns. Along the territorial road lines it is designed to erect a telegraph, and to make, in the first place, a common, cheap road, such as are usually made to meet the first requirements of settlers. It is also proposed as time rolls on to give employment to such of the poorer settlers as may stand in need of it in improving the road, having in view always its ultimate purpose, and thus to form the groundwork of the future railway by a series of progressive stages corresponding indeed with the progress of the settlement. It is designed that the line shall be used as a cart or waggon road in its rudimentary state; the rails to be laid and the railway to be completed only when the demands of traffic or the exigencies of the country require steam communication.

The scheme undoubtedly has much to recommend it. Settlers would know beforehand where the railway and road system of the country would be created, and they would govern themselves accordingly in selecting their locations. The trade of the country would grow up in the proper channels designed for it. There could be no railways built where they are not wanted, and they need not exist as railways until they are actually needed. Thus, ruinous competition would be avoided, and accumulated losses on unproductive capital might be greatly reduced or altogether saved. Traffic would, from the first, centre at the future stations, and, as a conse-

quence, at these points, settlements, merely villages at first, important towns in time, would spring up. A concentration of labour, year by year, on the territorial road would give the pioneer settlers needful employment, and would, in course of time, prepare it for the superstructure of the railway; while the occupation and cultivation of the land, and the development of other natural resources would prepare the country for railway services.

The scheme for the development of the highways of a new country appears peculiarly applicable to the circumstances of the case under consideration, if we shut out from our view all questions except simply the colonization of the interior of Canada. After the position of the lines has been determined on—and this should only be done after exhaustive examinations have been made—the next effort should be to complete telegraphic communication along the precise line of the future railway. The cost of a telegraph is so trifling compared with its advantages that it should be made the precursor of other means of communication. The telegraph erected, a bridle-path from post to post would probably be the first means of transport; then would follow a waggon or post road; finally, a perfect line of railway when the traffic of the country or the interests of the nation required more rapid means of communication.

The territorial road system was suggested 15 years ago at a period anterior to the agreement made with the Province of British Columbia, to build a continuous line of railway from one side of the continent to the other. If, for the moment, we view the transcontinental railway simply as a colonization line, the economical principles of the scheme then advocated appear as applicable to-day as they were formerly.

* * * * *

Since these views were first advanced, the circumstances upon which they were grounded have materially changed. Apart from the political and special considerations which enter into the discussion, we have acquired more accurate geographical and general information; and it would now appear that the habitable territory claiming attention is considerably more extensive than was at one time supposed. In consequence, a much more comprehensive railway and road system would seem to be required, and ought to be projected. Instead of a single line of railway through the fertile belt, at least two trunk lines, with cross connections and numerous branches, may ultimately be needed to serve the greater breadth of country. This does not, however, render it less important to regard the economical principles which ought to regulate the establishment of all the highways of the territory. The interior of Canada has, without any doubt whatever, a vast area of fertile soil; yet it cannot be denied that there are many drawbacks to contend with. It may be said that the climate, especially in the winter season, is one. The great distance of this fertile area inland is undoubtedly another, and perhaps the most serious; and this circumstance makes it the more imperative that, to afford the fullest opportunity for successful colonization, the lines of communication should be established on sound principles. The principles of the territorial road system, to which I have referred, appear to me of so fundamental a character that they are quite as applicable to-day as when they were first promulgated. The map which I have prepared shows the possible position of the leading railway lines which, based on the information we have recently acquired, may be projected for the future service of the country. In the west, lines are shown to reach the Pacific tide water at Port Simpson, at Burrard Inlet, and at Bute Inlet, with an extension to Vancouver Island, running to Esquimalt, Alberni, Fort Rupert and Quatsino. In the interior, the Bow River, Saskatchewan, Athabasca, Peace River, Lake La Biche, Swan River, Assiniboine, and Red River districts are proposed to be served by main lines or branches; while, to the east, lines are carried to Port Nelson, Moose Factory, Lake Superior, Ottawa, and to Saguenay below Quebec. Of course this is a mere projection, and it is presented to illustrate the comprehensive view which, in my opinion, should be taken of the question. All these lines, or modifications of them, I consider eligible for territorial roads; not that they should be built all at once, or even all, at once surveyed, but simply to complete the scheme of great thorough-

faires which, in course of time, may be established and used. They may at once be designated territorial road lines, and when they come to be surveyed they should be laid out with great care and forecast; a territorial road being understood to mean simply a railway in an incipient stage, capable of being used as a means of intercourse at all stages, its highest condition of development being a means of steam communication.

It may be assumed to be the desire of the Government and people of the Dominion that the great undeveloped interior of Canada should be colonized in the most successful manner possible. It could not be held to be successfully colonized unless peopled by inhabitants like themselves, hardy, self-reliant, vigorous, and determined; nor unless the many thousand miles of railway required were constructed in such a way as to leave them, when finished, in a condition to do their work efficiently and without loss. This certainly would not be the case if, through too hasty and ill-considered construction, or through any other cause, liberal Government grants, as well as private resources, were swallowed up, and the lines left burdened with debt which no future traffic could support or remove.

The system of highways to which I have referred is one of evolution, and would necessarily be of slow growth; it is, nevertheless, in my judgment, one which could not fail to succeed. It is, however, purely, a colonization scheme. I am prepared to admit that there are many weighty reasons why some one of the lines projected across the continent should be pushed to completion more rapidly than colonization purposes actually demand. I have already mentioned that the enterprise known as the Canadian Pacific Railway has been designed for a purpose beyond that of settling the vast interior of the country. One of its objects is to unite the Pacific and Atlantic coasts with a continuous line of railway without passing over foreign sea or soil.

How can I very briefly—for I fear I have exhausted your patience—how can I in fewest words set forth the immense importance to the Empire of having a line through Canada in operation as speedily as possible?

Esquimalt, the naval station on the Pacific, and possibly the great Pacific arsenal of the future, is some four month's steaming distance from England. I venture to state that by the projected Canadian Railways it would be possible to carry despatches from London to this station on the Pacific in thirteen or fourteen days, and that communication with New Zealand could be made in less time than has ever yet, so far as I have learned, been practicable.

In the construction of this railway the great Australian provinces, must surely be interested. It must be of some moment to every British station in the North and South Pacific Oceans. It would open up a new route to India! There would probably be less nervousness felt from day to day, and from month to month, here, in the heart of the Empire, about the Eastern Question if we had an overland route through Canada. And in this view the consideration of a very simple yet important Western Question may in some degree diminish the interest felt in a very complicated Eastern Question.

If it be admitted that the speedy completion of a railway across Canada is of general importance to the Colonial Empire, the question arises—which line could be most speedily constructed, and which, when established, would best subserve Imperial interests? This is the important question for present consideration and decision. As far as the colonization of the vacant parts of Canada is concerned, it is of no great consequence which of the lines ultimately required be first completed.

The resources of Canada are perfectly competent to establish in some such manner as that I have described all the highways wanted for opening up the country, but it would occupy many years to effect this in a satisfactory manner. If other and higher than local interests demand a through line of railway sooner than it is locally required, it seems a reasonable suggestion that those higher interests should in some way or other assist in obtaining it. As a member of the great Colonial family, Canada very largely participates in the higher interest, and as such it cannot be doubted that she is perfectly prepared to bear her full share of the cost of establishing the communications of the Empire."

My Lord Duke, ladies, and gentlemen,—I must beg your permission, before this passes out of my hands, to offer a personal explanation and apology. When first I was paid the compliment of being asked to read a paper on Canada, I felt I should best serve the Institute by declining, and thus leaving an opening for some one else more competent to do it. Subsequently, the Council was good enough to urge me to undertake the duty. I should have been glad had it fallen into worthier hands, as I feel that I have been unable to do the subject I have endeavoured to bring before you anything like justice. To make matters worse, a day or two ago, when preparing my paper, I received a cable message from the Canadian Government, urgently requiring me to leave by the first steamer. As a consequence I have been much hurried. I am conscious that my paper is ill-prepared; and as I sail in 24 hours, before these lines can be read to you, I shall, all being well, be approaching mid-Atlantic and speeding as fast as steam can take me to that country I have attempted, though imperfectly, to describe. You will probably think this, by cutting short my remarks, a happy interruption. I confess I have found the subject much too large for the limits of one paper. There are many points I should have wished to touch upon. I have not even mentioned that the construction of the Pacific Railway has already made considerable progress; that the locomotive is now to be heard snorting north of Lake Superior; that the steam whistle is screaming on the shores of Lake Winnipeg; and that the telegraph, the Pioneer of the Railway, has advanced so far that you may send a message from almost any street corner in London to Edmonton near the base of the Rocky Mountains. I should especially have desired to make you better acquainted with the four millions of Canadians with whom I have intermingled for nearly a life-time, and to have told you, if you need any assurance on that point, about their devotion to the old flag, their attachment to the Empire and to the Queen. Canadians glory in their connection with the little island across the water; they are proud of the progress they have made; and they may be pardoned for measuring their progress by comparisons. True, they may be considered an agricultural people, yet their outside trade is not trifling. They witness their shipping on the high seas with a tonnage greater than Germany possesses, double that of Spain, and nearly three times that of Russia. If with a small section, a mere corner of Canada, and that but sparsely populated, they have already a shipping trade which makes them almost the third maritime country in the world, what may they not hope for in another half century? It cannot be doubted that Canada possesses the elements of a great future; and that in a comparatively few years she may add incalculable strength to the British Empire. Canadians cannot strictly be called Englishmen, but they are proud to be British subjects; and they are by no means unwilling to join in the trials and struggles of the mother-country. They share in the advantages of British connection; and they would feel themselves unworthy of their name did they shrink from bearing their fair share of the burden and responsibility of consolidating and maintaining the prestige and power of the Empire.

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MAP
REFERRED TO IN REPORT ON THE
CANADIAN PACIFIC RAILWAY

Dated 26th April 1878

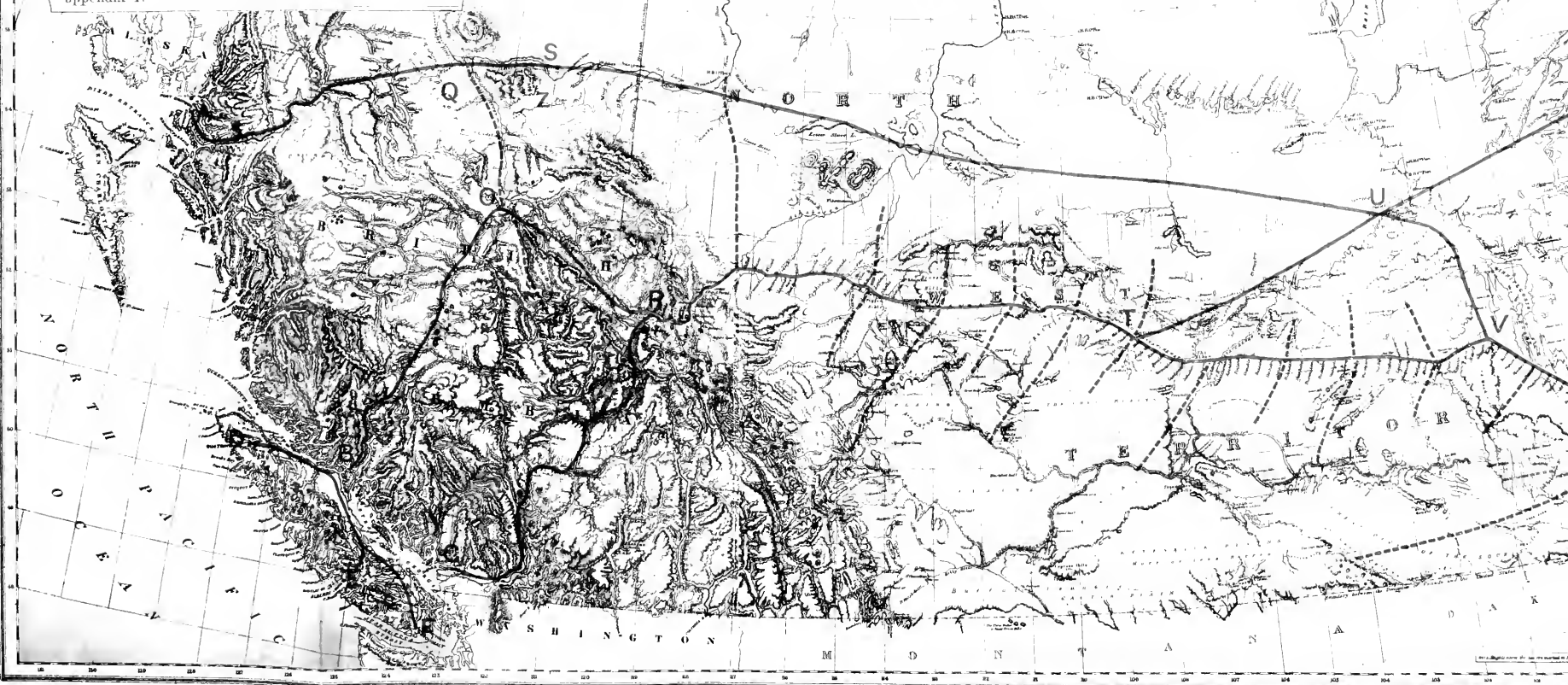
SHEWING VARIOUS PROJECTED LINES

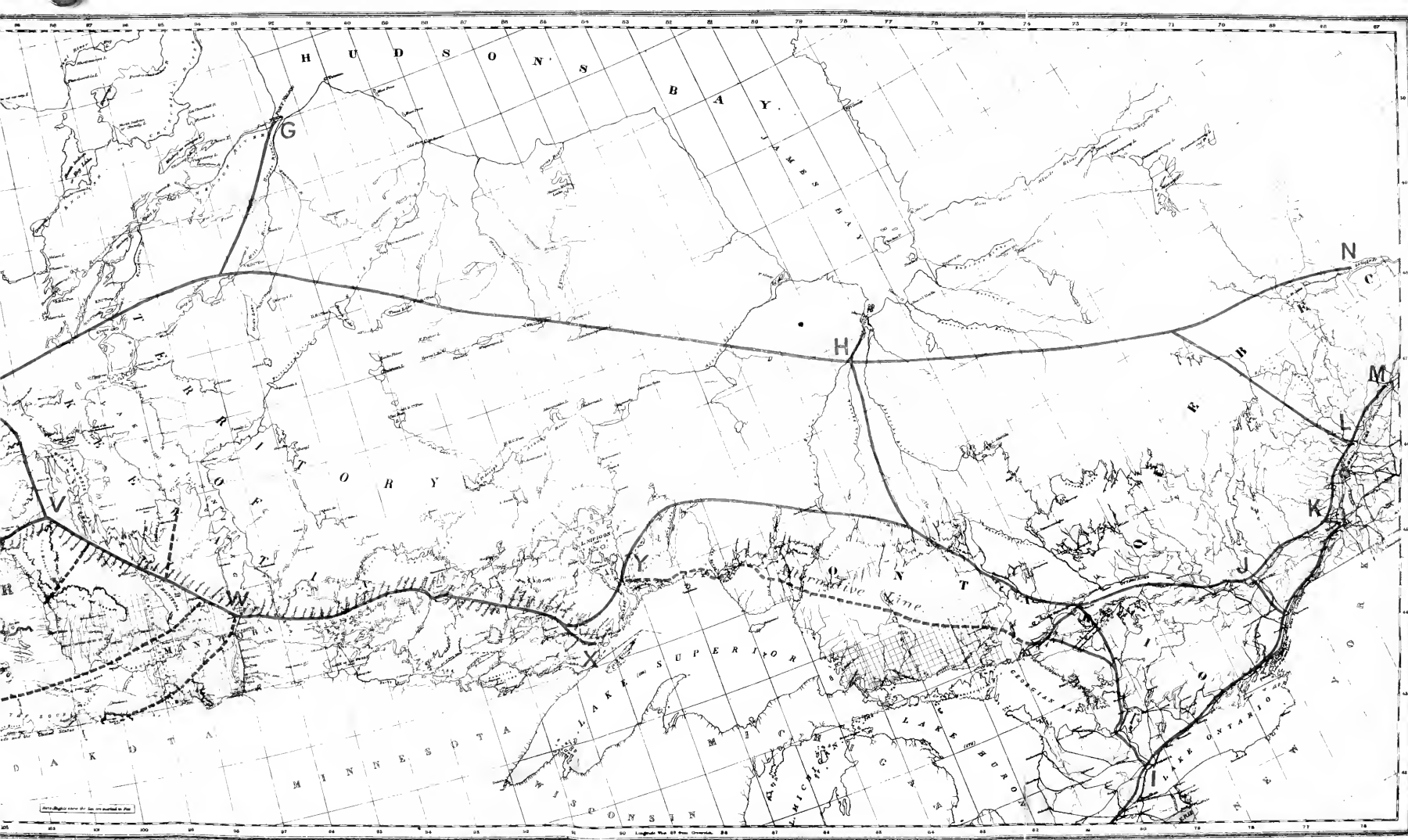
see explanation on separate sheet

SAMUEL FLEMING C. M. G.

Engineer in Chief

See Report
appendix I.





130 135 134 133 132 131 130 107

MAP
REFERRED TO IN REPORT ON
CANADIAN PACIFIC

Dated 26th April, 1878.

SHEWING VARIOUS PROJECT

See explanation on separate sheet.

SANDFORD FLEMING C. M. G.

Engineer in Chief.

See Report
appendix I.

Scale of Miles



APPENDIX I.

EXPLANATION OF MAP AND MEMORANDUM OF DISTANCES.

The full blue lines represent projected main railway routes, (territorial lines) which, possibly, may hereafter be considered necessary for the service of the country. Their purpose and character is alluded to in the General Report and Appendix II.

The large blue letters on the map indicate as follows:—

A	indicates	Port Simpson, on the Pacific Coast.
B	do	Bute Inlet, do
C	do	Burrard Inlet, do
D	do	Quatsino, do
E	do	Alberni, do
F	do	Esquimalt, do
G	do	Port Nelson, on Hudson Bay.
H	do	Moose Factory, on James Bay.
I	do	Toronto, on Lake Ontario.
J	do	Ottawa, the Seat of Government.
K	do	Montreal, on the Navigation of the St. Lawrence.
L	do	Three Rivers, do do
M	do	Quebec, do do
N	do	Saguenay, do do
O	do	Fort George, on the River Fraser, British Columbia.
P	do	The Cariboo Gold District, do
Q	do	The Omineca Gold District, do
R	do	The Yellow Head Pass, Rocky Mountains.
S	do	The Peace River Pass, do
T	do	Battleford, on the River North Saskatchewan.
U	do	Junction of projected lines, near Cumberland House.
V	do	Northcote Station, near Lake Winnipegosis.
W	do	Selkirk Station, in Manitoba.
X	do	Fort William, on Lake Superior.
Y	do	Nipigon, on Lake Superior.
Z	do	The Pine River Pass, in the Rocky Mountains.

The blue line from (C) Burrard Inlet, *via* (R) Yellowhead Pass, (T) Battleford, (V) Northcote, (W) Selkirk, to (X) Fort William, on Lake Superior, is the line located. Between (W) Selkirk and (X) Fort William it is in part, under construction. A telegraph is contracted for over this line from the Pacific coast to Lake Superior. It is erected and in operation over more than one-half the whole distance.

The dotted blue lines running to the right and left of the adopted route between (R) Yellowhead Pass and (W) Selkirk, represent branches projected for colonization purposes. With regard to which see the General Report and Appendix II. All the branch and main lines are intended to have the uniform gauge of the country (4 feet 8½ inches). The trunk lines are designed ultimately to be perfect in essential points in order to secure cheap transportation over long distances; the branches, however, being for local and light traffic may be more superficial in character.

The following will show the advantages and possibilities of some of the projected routes.

Taking a common point on the Asiatic coast,—Yokohama, in Japan,—the distances to points on the western shore of North America are:—

	Nautical Miles.
Yokohama to San Francisco.....	4,470
do Esquimalt (F).....	4,265
do Burrard Inlet (C).....	4,374
do Port Simpson (A).....	3,865

The estimated distance from these points to Atlantic tide water and various places is as follows:—

	Statute Miles.
San Francisco to New York	3,390
do Boston	3,448
Burrard Inlet (C) to New York, <i>viâ</i> Canadian Pacific, R. V. X., J. and Montreal (K).....	3,241
do Boston, <i>viâ</i> Canadian Pacific, R.V.X.J., and Montreal (K).....	3,197
do Montreal (K), <i>viâ</i> R. V. X.	2,862
do Quebec (M), <i>viâ</i> R. T. U. H. L.	2,880
do Saguenay (N), <i>viâ</i> R. T. U. H.	2,774
do Port Nelson (G), <i>viâ</i> R. T. U.	1,744
Port Simpson (A) to Montreal (K), <i>viâ</i> Peace River, U. W. Y. & J.	2,966
do Montreal (K), <i>viâ</i> Peace River, U.H.&J.	3,044
do Quebec (M), <i>viâ</i> Peace River, U. H. & L.	3,088
do Saguenay (N), <i>viâ</i> Peace River, U. & H.	2,782
do Port Nelson (G), <i>viâ</i> Peace River, & U.	1,752

The distances across the Atlantic may thus be stated:—

	Nautical Miles.
New York to Liverpool.....	3,040
Montreal to Liverpool, <i>viâ</i> St. Paul.....	2,990
do <i>viâ</i> Belle Isle.....	2,790
Quebec to Liverpool, <i>viâ</i> St. Paul.....	2,845
do <i>viâ</i> Belle Isle.....	2,645
Saguenay to Liverpool, <i>viâ</i> St. Paul.....	2,810
do <i>viâ</i> Belle Isle.....	2,610
Port Nelson to Liverpool.....	2,960

From the above the following table is compiled, distances by land being in statute miles, by water in nautical miles; and the total distances in statute miles:—

Yokohama to Liverpool.	Pacific Ocean. — Nautical Miles.	Railway. — Statute Miles.	Atlantic Ocean. — Nautical Miles.	Total* Statute Miles.
<i>Viâ</i> San Francisco and New York.....	4,470	3,390	3,040	12,038
<i>Viâ</i> Burrard Inlet (C), R. X. J. and Montreal (K):				
by St. Paul.....	4,374	2,862	2,990	11,341
by Belle Isle.....	4,374	2,862	2,790	11,111
<i>Viâ</i> Burrard Inlet (C), R. U. H. L. and Quebec (M):				
by St. Paul.....	4,374	2,880	2,845	11,193
by Belle Isle.....	4,374	2,880	2,645	10,363
<i>Viâ</i> Esquimaux (F), B. O. X. J. and Montreal (K):				
by St. Paul.....	4,265	3,165	2,990	11,519
by Belle Isle.....	4,265	3,165	2,790	11,289
<i>Viâ</i> Port Simpson (A), S. U. X. J. and Montreal (K):				
by St. Paul.....	3,865	2,966	2,990	10,360
by Belle Isle.....	3,865	2,966	2,790	10,330
<i>Viâ</i> Port Simpson (A) U. H. L. and Quebec (M):				
by St. Paul.....	3,865	2,888	2,845	10,315
by Belle Isle.....	3,865	2,888	2,645	10,385
<i>Viâ</i> Port Simpson (A), U. H. and Saguenay (N):				
by St. Paul.....	3,865	2,782	2,810	10,468
by Belle Isle.....	3,865	2,782	2,610	10,238
Port Simpson (A), U. to Port Nelson (G).....		1,752		
Port Nelson (G) to Liverpool.....			2,960	

The foregoing shows the importance of the projected Canadian system of railways as great through lines of communication, and points to special advantages which possibly may be possessed by Saguenay on the St. Lawrence, below Quebec and Port Nelson, on Hudson Bay. Surveys alone can determine the entire practicability of the portions of these lines through unexplored districts, but it would appear that a railway from Port Simpson to Saguenay, if established as sketched on the map, would, as compared with the line *via* New York and San Francisco, shorten the distance between Europe and Asia, according to the above estimates 1,570 miles. Saguenay would have this advantage during the season of navigation only; in winter, any traffic by this route would find its way *via* Quebec, over the Intercolonial to Halifax.

Port Nelson could scarcely be considered as a terminal point for transcontinental traffic; but as a shipping port for the products of the interior during some of the summer months, it may hereafter prove of value.* This is evident from the fact that a point in the heart of the Saskatchewan District, would, by way of Port Nelson, be nearer Liverpool than Chicago is by way of New York. A railway from Battleford, a point on the Saskatchewan, 557 miles west of Red River, to Port Nelson, would be about 770 miles in length, while Chicago is some 950 miles distant from New York, and New York is about 80 miles further from Liverpool than Port Nelson.

It may further be shown how advantageously Port Nelson is situated to the great fertile tract extending from Peace River easterly, and how important a railway such as that projected on the map may hereafter prove, if it be found practicable to carry products *via* Hudson Bay to England during even a limited portion of the year. By this route, Lac La Biche on the 112th meridian, and in the middle of an extensive district reported to be of rare fertility, would, by the projected line to Port Nelson be relatively nearer Liverpool than Chicago.

* Port Nelson River, or, as now termed, Nelson River, is the outlet through which drains the whole of the rivers and lakes included within the basin of Lake Winnipeg, extending from the Rocky Mountains on the west to within one hundred miles of the shores of Lake Superior on the east, and covering a drainage area of about 360,000 square miles.

Port Nelson is about eighty miles nearer to Liverpool, *via* Hudson Straits, than is New York. It is at the mouth of a river of the first class, carrying a body of water double that of the north and south branches of the Saskatchewan combined, and it reaches the sea through a narrow depression in the Laurentides, having a descent of about twenty inches in a mile, or, in round numbers, seven hundred feet in a little more than four hundred statute miles from the spot where it debouches from Lake Winnipeg.

Port Nelson, moreover, is about the same distance from the edge of a vast fertile region in the North-West, exceeding two hundred millions of acres in area, as Quebec is from Toronto.

For more than two hundred years from two to five sailing vessels, on an average, frequently with war ships conveying them, have sailed annually from Europe and America to Port Nelson, or other ports in Hudson Bay, and returned with cargoes the same season *via* the only available route, Hudson Straits.

In view of the growing interests of the North-West, from whatever point these may be regarded, the time for enquiry has arrived, whether communication with the Atlantic Ocean, with Port Nelson as a starting point, may not be made safe, speedy and economical. The enquiry has become a natural consequence of the extended knowledge now made public respecting the vast area in the North-West, suitable for grain growing and for pasturage, which the Government surveys have supplied. It is also encouraged by the great changes which have taken place during the last ten years in the prosecution of the sealing industry, which have established the fact that properly constructed vessels of large capacity are, in skilful hands, perfectly adapted to push their way through ice-encumbered seas. It has been pressed forward by the new industry, so rapidly rising into importance, which gives additional wealth to the prairies of the west and south-west in the United States, by the European demand for their live products as well as for their grain.

The establishment of a cheap and speedy means of communication between the North-West and the open Atlantic *via* Hudson Straits, would not only secure the rapid settlement of Manitoba, but open to successful immigration a fertile area twenty times as large as that Province. The proximity of this vast extent of country to its own seaboard would, under such conditions, also secure the carrying trade of its own productions under one and the same flag.—*Evidence of Prof. Hind before a Committee of the Commons of Canada, 1878.*

APPENDIX K.

LIVES lost in connection with the Survey, during the Years 1871, 1872, 1873, 1874, 1875, 1876, 1877 and 1878.

No.	Name.	Date of Death.	Remarks.
1871.			
1	Alexander Sinclair.....	August 7	Lost in forest fires.
2	William Matheson.....	do 7	do
3	Indian, name unknown.....	do 7	do
4	do do.....	do 7	do
5	do do.....	do 7	do
6	do do.....	do 7	do
7	do do.....	do 7	do
1872.			
8	do do.....	April 7	Drowned in North Thompson.
9	Arthur Hamilton.....	May 20	do Lake Temiscamingue.
10	Edward J. C. Abbott.....	do 20	do do
11	George Knout.....	do 20	do do
12	George Rochette.....	do 20	do do
13	Frederick Chadwick.....	Nov. 26	do Lake Huron.
14	William Caldwell.....	do 26	do do
15	T. D. Taylor.....	do 26	do do
16	Michael Clancy.....	do 13	Broke through ice.
1873.			
17	Joseph Hughes.....	July 21	Drowned in Whitefish Lake.
18	Arthur Torrie.....	do 24	do do
19	Neil Patterson.....	do 24	do do
20	John P. Robson.....	Oct. 2	Died.
21	Nathaniel L. Price.....	Dec. 30	do
1874.			
22	Wm. Tappige.....	Oct. 3	Drowned in Fraser River.
1875.			
23	John Spence.....	Sept. 29	do Dalles River.
24	Joe Paskall.....	do 29	do do
25	*Thomas Robinson.....	Nov. 4	Went down in steamer "Pacific"
26	*Edward Jaynes.....	do 4	do do
27	*Samuel Nicholson.....	do 4	do do
28	*John Tarbut.....	do 4	do do
29	*George Skippen.....	do 4	do do
30	*Richard Corcoran.....	do 4	do do
31	W. P. Scott.....	Dec. 31	Died.
1876.			
32	John Dolan.....	June 25	Drowned in North Thompson.
33	Isaac Howch.....	July 19	do Salmon River.
34	Samuel Londit.....	Oct. 16	do Kettle Falls.
1877.			
35	Robert McMillan.....	June 26	Died.
36	Louis Watters.....	Nov. 19	Broke through ice on Red Pine Lake.
37	F. G. Shibley.....	Dec. 10	Died.
1878.			
38	Samuel Hazlewood.....	Jan. 11	do

* These men had been paid off a few days previously.

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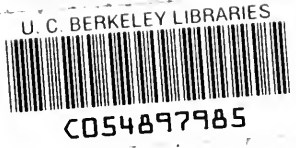
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